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PLANTS PRODUCED FROM SEEDS HAVING TWO, OR VERTICILLATE. SEED LEAVES.

THE

ELEMENTS

OF

BOTANY

FOR

FAMILIES AND SCHOOLS.

PUBLISHED UNDER THE DIRECTION OF
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PREFACE.

In the following pages, the elements of Botany are explained, as at present taught by the first professors in this and other countries, to whom it is chiefly indebted for the rank it now holds among the different branches of physical science.

Botany was for a long time regarded, by those who were not aware of its real nature and object, as a science of classification and names only, an exercise for the memory rather than for the faculties of judgment and observation; and this erroneous opinion was confirmed by the display of a superficial knowledge made by those who were content to be conversant with the *names* only, and not with the *properties* and *structure* of plants.

The real importance of the science is now fully acknowledged; it facilitates the acquisition of the necessaries of life, by pointing out those characters which distinguish the plants useful for food, clothing, or medicine; it is by the increased knowledge of the laws of vegetation, combined with that of chemistry and other sciences, that those improvements in agriculture have been effected, which cause two ears of wheat to grow where only one grew formerly; and by the same means, the empirical recipes of former days have been supplanted by those specifics which have so materially alleviated human suffering; while botanical geography is daily throwing more and more light on collateral sciences essential to the welfare of nations.

One advantage which Botany possesses may be properly pointed out here; it requires no investigations which, by compelling that disregard to the sufferings of animals necessary in studying other branches of natural history, cannot but distress a feeling mind; for this reason it is especially a *feminine* pursuit, and perhaps there are few occupations in which the mother of a family may be more pleasingly engaged, than in pointing out to her children the beautiful structure of the flowers of the field; and, lastly, though in this respect it can lay no claim to superiority over those other branches, yet none can more constantly or more strongly remind the learner of the power, wisdom, and goodness of Him who thus spoke by his prophet:

"I will plant in the wilderness, the cedar, the shittah-tree, and the myrtle, and the oil-tree; I will set in the desert, the fir-tree, and the pine, and the box-tree together.

"That they may see, and know, and consider, and understand together that the hand of the Lord hath done this, and the holy One of Israel hath created it."

NOTICE TO THE THIRD EDITION.

The work has undergone a careful revision, and considerable additions have been made, especially to the chapters on vegetable physiology, which were too concise in the former editions. This has been rendered necessary by the rapid progress that has been made in the Science, even since these Elements were first published.

ANALYTICAL TABLE OF CONTENTS.

Page
SIGNIFICATION AND DERIVATION OF BOTANICAL TERMS . 7

INTRODUCTION . . . 17
Object of Botany . . 17
Inorganized bodies . . 17
Organized bodies . . 17
Plants distinguished from animals 17
Principal compound organs of plants 18
——— organs of nutrition 18
——— reproduction 18
Simple organs. . . 18

THE ROOT 18
Definition of 18
Tap or pivot root . . 19
Fibrous root . . . 19
Bulbiferous root . . . 20
Parasitical plants . . 20

THE STEM, OR AXIS . . . 20
Definition and characteristic of 20
Trunk 21
Stipe 21
Culm 21
Stem 22
Stemless plants . . 23
Nodi and internodia . . 24

THE LEAVES 24
Definitions and characteristics 24
Where produced on plants 25
Alternate leaves . . . 25
Opposite leaves . . 25
Verticillate leaves . . 26
Origin of different organs. 26
Arrangement of veins . . 26
Double set of veins . . 27
Simple leaves . . . 27
Compound leaves . . 28
Anomalous leaves . . 31
Unsymmetrical leaves . 32
Varieties of forms of leaves on the same plant . . . 32

Page
Leafless plants . . . 32
Stipulæ 32
Irritability of leaves . . 33
Evergreens . . . 35

THE BUD 35
Definition and characteristics 35
Flower-buds . . . 35
Leaf-buds . . . 36
Buds of stemless plants . 37
Bulb 37
Irregular or accidental buds 37
Imperfect buds . . . 38
Vernation of leaves . . 38

OF HAIRS AND GLANDS . . 38
On what part of plants hairs are found . . . 38
Lymphatic hairs . . . 39
Secreting hairs, or glands 39
Various forms and appearances of glands . . 39
The use of glands in plants not known . . . 39
Thorns and prickles . . 40

THE FLOWER 40
Definition of . . . 40
Flower-buds 40
Inflorescence . . . 41
——— forms of . 41

OF BRACTEÆ 44
Involucrum . . . 45

THE CALYX 47
Sepal 47
Monosepalous and polysepalous calyx . . . 47
Regular and irregular calyx 47
Deciduous or persistent . 48

THE COROLLA . . . 49
Petal 49
Monopetalous and polypetalous corollas . . . 49

Page
Regular and irregular corollas 50
Papilionaceous corolla . 50
Orchideous corolla . . 51
Cruciform corolla . . 51
Florets 52
Perianth 53
Æstivation 54

The Stamens 55
The anther and filament . 55
Pollen 55
Insertion of the stamens . 58
Stamens are leaves modified 58
Double flowers . . . 60

The Pistil 60
Carpellum, or modified leaf, of which the pistil is composed 60
Ovarium, style, stigma . 61
Arrangement of the parts composing the flower . . 63
Ovarium, inferior . . 63
——— superior . . 64
Disk, nectaries, &c. . . 64
Unisexual and neuter flowers 64

The Fruit 65
Divisible into separate parts 65
Dehiscence . . . 66
Indehiscence . . . 66
Fruits, classed into simple, aggregate, compound, and collective 67

The Seed 73
Integuments, or coats . . 74
Embryo 74
Plumule 75
Radicle 75
Cotyledons 76

Of the Internal Structure of Plants . . . 78
Cellular tissue . . . 78
Woody fibre . . . 81

Page
Vascular tissue . . 82
Ducts 82
Spiral vessels . . . 82
Cuticle 83

Of the Structure of the Stem 84
Dicotyledonous stems . . 84
Monocotyledonous stems . 87

Of Germination . . . 88
Formation of liber and alburnum 89

Of the Food and Secretions of Plants . . . 92
Sap 92
— its motion in plants . 92
— Cambium formed from 93
Effects of light on plants . 93

Of Flowerless Plants . 94
Ferns 95
Mosses 95
Lichens 96
Fungi 96
Algæ 97

General Observations on Vegetation . . 98
Different manifestations of irritability . . . 98
Appearances of vegetation in different climates . . 99

Of the Classification of Plants 101
Principles on which this is founded, exemplified . 101
Linnæan system . . 107
Tabular view of . . 113
Natural arrangement . . 114

Conclusion 129

List of Plants . . . 132

This Table of Contents may be used by the Teacher as the foundation of a series of Questions for Examination, where that mode of instruction is adopted.

SIGNIFICATION AND DERIVATION

OF A FEW OF THE

PRINCIPAL TERMS EMPLOYED IN BOTANY.

N.B. Many of the names have a corresponding adjective and the reverse, though only one term is given in this glossary.

s. signifies a substantive ; *a.* an adjective ; *p.* a participle.
gr: . . that the word is derived from the Greek.
lat: . . . . Latin.

A, in composition with other words, generally implies *deprivation* or *absence* ; see Apetalous, Acotyledonous, &c.

Achlamydeous, *a.* plants not having floral envelopes are so termed ; gr: *without a tunic*, or *cloak*.

Akénium, *s.* a species of *fruit* ; from gr: *not opening.*—*Ex* : Borage.

Acotyle'donous, *a.* *not having cotyledons* (see Cotyledon).

Acrogenous, *a.* a term applied to a large class of plants not produced from seeds of the usual structure, and expressive of their mode of growth ; gr: *produced irregularly*, or *indefinitely*.

Æstivation, *s.* the mode in which the parts of a flower, taken separately, are arranged in the bud ; lat: *relating to Summer.*

Albumen, *s.* the substance surrounding the embryo in the seed ; lat: *the white of an egg.*

Albu'rnum, *s.* the last-formed wood of the trunk of trees and woody plants ; lat: the same meaning.

Améntum, *s.* *a catkin*, one kind of inflorescence (see p. 42) ; lat: *a strap.*—*Ex* : The inflorescence of the Willow, Chestnut, &c.

Amplexicaulent, *a.* *embracing the stem* ; lat: same meaning.

Anastomósing, *p.* applied to fibres or threads, which, by meeting or touching in separate points only, thus form a sort of net-work ; gr:

Angiospermia, *s.* an order of plants ; gr: *vase-seed*, or *covered-seed.*

Annual, *a.* plants are so called that grow, ripen their seed, and die, in one year ; lat: *yearly.*—*Ex* : Sweet-pea, Tro-

ANTHER, *s.* the important part of the stamens of most flowers; the plural, correctly, is *anthera* (see p. 55); gr: *a flower.*

APE'TALOUS, *a. not having petals;* see Petal, and A.

APEX, *s. the summit, top,* or *point* of any thing, as a leaf, a fruit; lat: the same meaning; plural, *apices.*

Aríllus, *s.* a substance enclosing the seed in some plants (see p. 74).—*Ex:* Mace.

AXILLA, *s.* the angle formed by the stalk of a leaf, &c., with the stem; lat: an *arm-pit.*

AXIS, *s.* in Botany, means the imaginary central line of different parts of a plant, round which leaves, or modified leaves, are produced. The stem is also so called, for this reason.

Bi, in composition with other words, generally implies *two,* or *twins;* see following words.

Biennial, *a.* plants are so called which do not bear flowers and seed till the second year, and then die; lat: *two-yearly.*—*Ex:* Parsley.

Bifid, *a. cloven,* twice cut; lat: same meaning.

Bilábiate, *a.* two-lipped; lat: same meaning.

BINARY, *a.* arranged by twos; lat: signifying by *couples.*

Botany is a Greek word for plant, and is derived from a verb, meaning *to feed.*

BRA'CTEA, *s.* the modified leaf in the axilla of which the flower-bud is produced (see p. 44); lat: *a thin leaf;* pl. bracteæ.

Bud, *s.* the part of a plant by which the *individual* is propagated, and containing rudimentary leaves (see p. 35).

Caly'ptra, *s.* a part of plants of the moss-tribe (see p. 96); gr: *a covering,* and hence *an extinguisher,* which it resembles.

CA'LYX, *s.* the outer envelope of the flower (see p. 47); pl: calyces; gr: *a covering.*

CA'MBIUM, *s.* a thickish juice formed between the bark and the alburnum (see p. 90): lat: signifying *to change.*

Campánulate, *a. bell-shaped,* applied to the calyx or corolla; lat: *a bell.*

CA'PSULE, *s.* a species of *fruit;* lat: *a small chest,* or *case* (see p. 69). *Ex:* Poppy.

Cárinate, *a. keel-shaped;* lat: *a keel.*

CARPE'LLUM, *s.* a leaf in a particular state of modification (see p. 60); gr: *a small fruit.*

Carpólogy, *s.* a branch of Botany which treats of fruits; gr: *fruit-discourse.*

CELLULAR, *a.* containing *cells,* opposed to vascular (see p. 78); lat: *little cell.*

Chaláza, *s.* a swelling on the outside of the seeds of some plants (see p. 75); gr: *a small grain, hail.*

Commissure, *s.* the part where two carpella are united in the fruit; lat: *union, conjunction.*

Convérging, *p. approaching towards;* lat:

CORO'LLA, *s.* the inner of the floral envelopes when there are two (see p. 49); lat: *a small crown.*

Córmus, *s.* a particular species of subterraneous stem (see p. 23); gr: *a trunk of a tree.*—*Ex:* Crocus, Arum, &c.

CORYMB, *s.* a kind of inflorescence (see p. 43); gr: the *top, vertex, summit.*—*Ex:* Red Valerian.

COTYLE'DON, *s. the seed-leaf,* or *seed-lobe* of seeds (see p. 76); gr: *a cavity.*

Crenated, *a. cut into round teeth;* lat:

CRYPTOGA'MOUS, *a.* a term applied to plants not bearing flowers with stamens and ovarium visible; gr: *concealed marriage.*

Cúpule, *s. the cup* of an acorn and similar fruits; lat: *a little cup.*

Cúticle, *s. a thin skin;* lat: *a little skin.*

Culm, *s. the stalk of grasses,* and similar plants (see p. 21): lat: same meaning.

CYME, *s.* a kind of inflorescence (see p. 44); gr: *a wave, a young shoot.*—*Ex:* Elder, Dogwood, &c.

DECI'DUOUS, *a. falling off, withering;* lat: *to fall off.*

Decúrrent, *p. running down* (see p. 30); lat: same meaning.

DEHI'SCENT, *p. opening* (see p. 66); lat: *gaping.*

Déntate, *a. toothed;* lat: same meaning.

Di, in composition with other words, means generally *two,* or *double;* see the following terms.

Dichótomous, *a. branching in pairs;* gr: *to cut in two.*

DICOTYLE'DONOUS, *a. having two seed-lobes,* or *seminal leaves* (see p. 76).

Didynámous, *a.* a term applied to a peculiar growth of the stamens (see p. 58); gr: *double two-threaded.*

Digitate, *a. shaped like fingers;* lat: *fingered.*

Diœcious, *a.* plants are so called, which have the male flowers on one individual, and the female on another (see p. 111); gr: *two houses.—Ex:* Date, Hop, Spinach, &c.

Dissépiment, *s. the partitions in fruits* (see p. 61); lat: *boundary* or *partition.*

Dorsal, *a. belonging to the back of any thing;* lat: same meaning.

Drupe, *s.* a species of *fruit* (see p. 67); gr: *an olive; a fruit ripe,* or *ready to fall.—Ex:* Peach, Plum, &c.

Duct, *s. a tube* or *vessel* (see p. 82); lat: *led, conducted.*

E'ndocarp, *s.* the inner part of fruits (see p. 65); gr: *within-fruit.*

Endógenous, *a.* a term applied to a large class of plants, expressing the peculiar mode of their growth and structure (see p. 114); gr: *born* or *produced within.*

Endorhizæ, *s.* a term applied to those plants, the radicle of which ruptures the integument of the seed in germination; gr: *internal root.—Ex:* Larkspur, Pæony.

Epi, in composition with other words, generally means *upon;* see following words.

Epicarp, *s.* the outer coat of fruits (see p. 65); gr: *upon-fruit.*

Epidermis, *s. outer skin* (see p. 86); gr: *upon-skin.*

Epigy'nous, *a.* a term applied to a peculiar position or arrangement of the stamens in the flower; gr: *upon-female.*

Exógenous, *a.* a term applied to a large class of plants, expressing the peculiar mode of their growth and structure (see p. 114); gr: *produced without, or externally.*

Exorhizæ, *s.* a term applied to plants, the radicle of which lengthens in germination, without rupturing the integument; gr: *external root.*

Farína, *s. meal,* or *flour;* farinaceous, is applied to those parts of vegetables which yield starch; lat: *corn.*

Filament, *s.* the thin support of the anther (see p. 55); lat: *thread.*

Fístulous, *a. tube-like, hollow;* lat: same meaning.

Flóral, *a.* belonging to the flower; lat: same meaning.

Fóllicle, *s.* a species of *fruit* (see p. 67); lat: *a little sac,* or *pouch.*

Forámen, *s.* the *opening* in the ovulum (see p. 74); lat: *a hole.*

Frond, *s.* the *leaf-like parts* of certain plants (see p. 94); lat: *a leaf.—Ex:* Fern, Moss, sea-weeds.

Ga'mopetalous, *a.* the proper term for *monopetalous;* which see; gr: *married leaves.*

Ga'mosepalous, *a.* the proper term for *monosepalous;* which see.

Gland, *s.* a particular organ in plants (see p. 39); lat: *an acorn.*

Glaucous, *a. blueish-gray;* applied to leaves, and the herbaceous parts of plants, to distinguish them from the usual green; gr: *dark, blind,* and hence *uncertain,* or *indistinct.*

Glume, *s.* a name for parts of the flower of certain plants (see p. 54); lat: a *husk* or *shell.*

Gynandrous, *a.* a term applied to a particular class of plants in which the stamens and ovarium are united (see p. 57).

Gymnospermia, *a.* a division of plants (see pp. 110, 114); gr: *naked seeds.*

Hastate, *a. spear-shaped;* lat: same meaning.

Herbaceous, *a.* of the texture of leaves, or green vegetable matter; lat: *grass-like.*

Herma'phrodite, *a.* plants are so called, the flowers of which contain both stamens and ovarium, in distinction to Monœcious and Diœcious; gr: a fabulous name compounded of those of Mercury and Venus, Hermes and Aphrodite.

Hilum, *s.* the mark on seeds showing the place where they were joined to the fruit; lat: *the least thing possible.*

Hirsute, *a.* rough with hairs; lat: same meaning.

Hispid, *a.* rough with stiff hairs; lat: same meaning.

Hymenium, *s.* the part in certain flowerless plants analogous to the ovarium.

Hypogynous, *a.* a term applied to a peculiar arrangement of the stamens in a flower (see p. 59); gr: *under-female.*

I'mbricate, *a.* overlapping like the tiles of a roof, applied to the æstivation and to the involucrum; lat: *tiled.*

Indehi'scent, *p. not opening;* see Dehiscent.

Indígenous, *a. native of* a country; gr: lat: *born in.—Ex:* The oak is *indigenous* in England.

Inflore'scence, *s.* a term applied to the arrangement of the flowers on plants (see p. 41); lat: *to begin to be flowered.*

Involu'crum, *s.* a leafy envelope to a number of flowers growing in a head (see p. 45); lat: *a case,* or *covering.*

Lamina, *s.* the *thin flat part* of a leaf (see p. 24); lat: a thin *leaf* or slice of any thing.

Lánceolate, *a. lance-shaped,* narrow and tapering; lat: same meaning.

Legúme, *s.* a species of *fruit* (see p. 67); lat: a *pod.—Ex:* Pea, Bean.

LIBER, *s.* the inner, woody tissue of the layers of bark (see p. 85); lat: *a book.*

Medúllary, *a.* relating to the pith; lat: *marrow.*

Membranous, *a.* *thin, dry,* and *skin-like;* opposed to herbaceous; lat: same meaning.

Micropyle, *s.* a term for the *foramen* in the perfect seed (see p. 75); gr: *small door.*

Mon, or **Mono**, in composition with other words, generally means *single, one,* or *solitary;* see following words.

MONOCOTYLE'DONOUS, *a.* having only one seed-lobe, or seminal leaf (see p. 76).

MONŒCIOUS, *a.* plants are so called which have male flowers, or flowers with stamens only, and female flowers, or flowers with an ovarium only, on the same individual (see p. 111); gr: *one-house.—Ex:* Chestnut, Birch, Indian-corn, &c.

MONOPE'TALOUS, *a.* applied to the *corolla* of a flower, when the *petals* which compose it are united by their edges, and hence appear as if there were but *one* (see p. 49).

Monophy'llous, *a.* having *one leaf* only, or formed of *one leaf;* gr: same meaning.

MONOSEPALOUS, *a.* applied to the *calyx* of a flower when the *sepals* which compose it are united by their edges (see p. 47).

Múcronate, *a.* ending in a point (see p. 30); lat: same meaning.

Narcotic, *a.* provoking sleep or torpor; gr: same meaning.

NODUS, pl: NODI, *s.* the point or points on the axis of a plant where leaves are developed and leaf-buds formed; lat: *a knot.*

NORMAL, *a.* agreeing with the, presumed, regular structure of the class or order to which a plant belongs; lat: *regular, formal,* from a *measure of angles.*

Nucleus, *s.* the central part of the ovulum which becomes the embryo (see p. 74); lat: *kernel.*

OVARIUM, *s.* the part of the pistil which ripens into the fruit and contains the seeds (see p. 61); lat: from the word for an egg.

Ováte, *a.* *egg-shaped;* lat: same meaning.

OVULUM, *s.* the seed before it is perfected; pl: ovula (see p. 74); lat: a *little egg.*

PALEA, *s.* a small membranous or chaffy bractea in a certain form of inflorescence (see p. 45); lat: *chaff.*

Palmate, *a.* resembling a *hand;* lat: *palmed*, or *hand-like.*

PANICLE, *s.* one kind of inflorescence (see p. 44); lat: *bunch*, or *cluster.*—*Ex:* Millet-grass, Oat, &c.

PAPPUS, *s. a feathery crown* to certain seeds; a form of calyx (see p. 72); gr: implying *bearded.*

Parasítical, *a.* plants are so called that derive their nutriment from others, and not directly from the earth (see p. 20).

PARENCHYMA, *s.* the *pulpy substance* of parts of all plants (see p. 78); gr: *fluid diffused.*

PARÍETAL, *a.* a term expressing an adhesion to the inner side of an organ; lat: *belonging to a wall.*

Pédate, *a. resembling a foot;* lat: same meaning.

Pedúncle, *s.* a term for the *stalk of a flower.*

Péltate, *a.* a term used to express that the stalk is joined to the surface of the lamina of a leaf, and *not* to the edge; lat: *provided with a small shield.*

Pepo, *s.* a species of *fruit;* lat: name for *a kind of melon.*—*Ex:* Cucumber.

Perennial, *a.* plants are so called that live *many years*, and bear flowers and fruit often; lat: *many years.*—*Ex:* Trees, Shrubs.

Perfoliate, *a.* a term applied to a stem which appears to pass through the leaf (see p. 30); lat: *through the leaf.*

Peri, in composition, generally means *about, round;* see following words.

PERIANTH, *s.* a term applied to the calyx or corolla, or to the floral envelopes (see p. 53); gr: *about the flower.*

PERICARP, *s.* the *fruit* considered separately from the seed (see p. 65); gr: *about the fruit.*

PERIGY'NOUS, *a.* a term applied to a peculiar arrangement of the stamens in the flower (see p. 59); gr: *about the female.*

Persístent, *a. not withering and falling*, opposed to deciduous; lat: *remaining permanent.*

PE'TAL, *s.* the name of each of the pieces of which the *corolla* of the flower is composed (see p. 49); gr: *a leaf.*

PE'TIOLE, *s.* a term for the *stalk of the leaf;* lat: a *foot-stalk.*

PHÆNÓGAMOUS, *a.* a term applied to all plants which have the stamens and ovarium distinctly perceivable; gr: *visible marriage.*

Physiology, *s.* the science which treats of organs of animals or plants; gr: *discourse on nature.*

Pinnate, *a.* a term applied to compound leaves (see p. 28); lat: *feathered.*

Pinnatifid, *a.* *cut like a feather;* a term applied to leaves (see p. 29); lat: same meaning.

Pistil, *s.* the central part of the flower in which are enclosed the seeds; it consists of the ovarium, style, and stigma (see p. 60); lat: *a pestle.*

Place'nta, *s.* that part of the *ovarium* to which the seeds are attached.

Plumule, *s.* the part of the embryo which grows upward out of the earth, and becomes the stem and leaves, &c. (see p. 75); lat: *a little feather.*

Poly, in composition with other words, generally means *many, several;* see following words.

Polypetalous, *a.* applied to the corolla of a flower, when the petals are separate.

Polysepalous, *a.* applied to the calyx of a flower when the sepals are separate.

Polyspermous, *a.* applied to the ovarium and fruit when they contain *many seeds.*

Pome, *s.* a species of *fruit;* lat: *an apple.*—*Ex:* Apple, Pear.

Pseudo, in composition with other words, means *false.*—*Ex:* pseudo-tuber, a false tuber, &c.

Pubéscent, *a.* *downy;* lat: same meaning.

Pyxid, *s.* a species of *fruit;* gr: word for *box-wood*, and hence for *a box.*—*Ex:* Anagallis.

Quinary, *a.* applied to things arranged in order by *fives;* a flower is said to have a quinary division, when it has five sepals, five petals, and five stamens, or twice as many.

Race'me, *s.* a kind of inflorescence (see p. 41); lat: a *cluster*, or *bunch.*—*Ex:* Hyacinth, Cross-leaved Heath, Shepherd's-purse, &c.

Ra'dicle, *s.* the part of the embryo, which grows downward, and becomes the root (see p. 75); lat: a *little root.*

Rhizoma, *s.* a species of *stem* (see p. 24); gr: a *root.*—*Ex:* Iris.

Rúncinate, *a.* cut into teeth turning backwards like a scythe; lat: *to mow.*

Sagíttate, *a.* arrow-shaped: lat: same meaning.

Sárcocarp, *s.* the *fleshy part* of the fruit; that which lies between the epicarp and endocarp (see p. 65); gr: *fleshy fruit.*

Scabrous, *a. rough, warty;* lat: same meaning.

Sepal, *s.* the name of each of the pieces of which the calyx of the flower is formed (see p. 47).

Sessile, *a.* any part of a plant which is commonly borne on a stalk, is said to be *sessile* when it has none; lat: *seated.*

Silicula, *s.* a species of *fruit;* lat: a *little pod,* or *shell.*—*Ex:* Honesty, Wall-flower, Radish.

Siliqua, *s.* a species of fruit; lat: a *pod,* or *shell.*

Spathe, *s.* a kind of bractea (see p. 45); lat: a *spatula,* and hence meaning the same.

Sporules, *s.* the name given to what are analogous to seeds in certain plants (see p. 95); gr: a *seed.*

Sta'men, *s.* the principal organ in the flower (see p. 55); pl: *stamens* or *stamina;* it consists of the *filament* and *anther;* lat: a *thread,* the *warp,* or *principal thread.*

Stigma, *s.* the apex of the pistil (see p. 61); gr: a *mark impressed.*

Stoma, pl: stomata, *s.* the pores of the cuticle of flowering plants; gr: *a mouth.*

Tegmen, *s.* one of the *coats of the seed* is so called; lat: a *covering.*

Ternary, *a.* applied to things arranged in order by *threes;* thus a flower is said to have a *ternary* division of its parts when it has three sepals, three petals, and three stamens, or twice or thrice as many; lat: same meaning.

Testa, *s.* the *coats* of the seed (see p. 74); lat: a *case,* or *vessel,* or *shell.*

Tetradynámous, *a.* a term applied to a peculiar growth of the stamens (see p. 58): gr: *four two-threaded.*

Thallus, *s.* the name for the *frond* of certain plants (see p. 96); gr: *green leaf.*

The'cæ, *s.* the minute *cases* in which the sporules of certain plants are enclosed (see p. 95); gr: *sheath, case.*

Thy'rsus, *s.* a kind of inflorescence (see p. 44); gr: *a staff* ornamented with grapes or ivy, an attribute of Bacchus. *Ex:* Lilac.

Tra'cheæ, *s.* a name for the *spiral vessels* (see p. 82); gr: *rough,* and thence an *artery,* or *tube.*

Tri, in composition with other words, means *three:* as *trifid*, three-cleft; *triandria*, three stamens; *trilocular*, three-celled.

Tu'ber, *s.* a form of the *stem* (see p. 24); lat: *a kind of fruit.* —*Ex:* Potato.

U'mbel, *s.* a kind of inflorescence (see p. 43); lat: an *umbrella*, or parasol.—*Ex:* Garlic, Pelargonium, Parsley, Carrot, &c.

Urcéolate, *a. pitcher-shaped*, applied to the calyx and corolla; lat: same meaning.

Valves, *s.* the pieces into which a dehiscent fruit separates; lat: *the wings of a door*, &c.

Va'scular, *a.* containing *vessels*, or tubes; lat: same meaning.

Ve'rticil, *s.* same as Whorl, more than two things growing round an axis, and lying in the same plane (see p. 26); lat: similar meaning.

Viscid, *a. thickish, juicy*, and *sticky*, like syrup; lat: same meaning, from the word for the misleto.

Whorl; see Verticil.

N.B. Those words which are printed in capitals in the foregoing table, should be committed to memory, as being the most important.

BOTANY.

INTRODUCTION.

BOTANY is the science which treats of the structure and properties of *Plants*, from the largest tree to the simplest sea-weed.

All bodies are either *inorganized* or *organized*.

Inorganized bodies are destitute of *life* or *vitality:* as stones, metals, water, air.

Organized bodies are possessed of vitality; and are either *animal* or *vegetable*.

These two divisions of organized bodies are, *generally*, very easily distinguishable from each other; but it is impossible to decide to which some bodies belong, or strictly to define the limits of the two divisions.

Plants or vegetables have not the power of locomotion, as most animals have. The food of plants consists of water, air, and a small quantity of other mineral matter; the food of animals consists of vegetables, or of other animals. That is, the former are nourished by inorganic, the latter by organic matter.

Plants, as well as animals, are provided with *organs* essential to their existence; each organ, or set of organs, is adapted to some particular use; thus, in animals, the eyes are the organs of sight, the lungs the organs of breathing, and so on.

The sciences which treat of the structure, form, and use of organs, are called *anatomy* and *physiology*.

Plants are entirely composed of a few simple *elementary* organs, from which are formed the compound organs; but these latter are greatly varied in appearance in the different species.

The principal compound organs of *perfect* plants are the *root;* the *stem*, or *axis*, with its appendages; the *leaves*, and parts belonging to them; the *flower;* the *fruit;* and the *seed:* but these are not found in one large class which *appear* to be composed solely of elementary organs, as will be subsequently explained.

The first three are called *organs of nutrition*, or those which serve to *nourish*, preserve, or to increase or extend the plant. The others are called *organs of reproduction*, or those which enable the plant to continue its species, by the production of new individuals.

The simple elementary organs of which the above are composed, are *cellular* and *vascular tissue;* but the compound organs will be first described, as being most obvious, and easily examined.

The many distinguishing terms rendered necessary by this variation in the organs, are usually derived from the Greek or Latin languages; but, though apparently difficult to remember, the beginner need not be discouraged, for the *names* of things, though necessary, are unimportant compared with the knowledge of the things themselves. If, therefore, he be acquainted with the objects, their *uses*, and *mutual relations*, it is of little consequence whether he remember their *names* or not; besides, this apparent difficulty will soon vanish, if the simpler primary terms are imprinted on the memory, the others being generally compound words.

THE ROOT.

The root is the organ which chiefly supplies the plant with water for food; and, as this is derived from the earth, the root is generally buried in the ground.

That part is alone considered as root, which grows in an opposite direction to the stem, from which it is also distinguished by not producing any buds. Hence no part that produces buds is to be considered as a root, however much it may at first sight resemble one.

The greater number of plants have roots, while the remainder have none; this subject will be again recurred to.

The principal kinds of roots are:—

The *tap* or *pivot root* which is, (1,) *simple*, long and taper; as the carrot, beet, and parsnep: or like a flattened globe; as the turnip and bulbous ranunculus, (2,) *Branched*, consisting of one principal stem sending out branches, and these again dividing into smaller, till they become thin fibres. Most large trees and shrubs have branched roots; and it is known that the thickest and longest branches of the root are those nearest the surface of the ground.

One important distinction between the root and the stem, consists in the irregularity of the *branching* or *ramifications* of the former, while the arrangement of the branches in the stem is regular; though, from accidental causes, this symmetry is frequently destroyed.

The *fibrous root* consists of a quantity of long thin fibres, of different lengths and thickness, and having still finer springing from them. *Ex:* wheat, barley, and most grasses.

Fibrous roots have occasionally small knobs or swellings on their fibres; as the *Lathyrus tuberosus*, and a species of meadow-sweet (*Spiræa filipendula*).

The root of the common bladder-wort has small hollow bubbles upon it, whence its name.

The roots of many plants are fleshy, and composed of one or more lobes; such as the common pig-nut, the Cyclamen, and the Dahlia. Others are furnished with a flat base, sending down a fibrous root from its under-side, while on the upper, a species of *bud* called a *bulb* is produced, which will be hereafter explained. *Ex:* onion, hyacinth, lily, &c. Such roots are called *bulbiferous* roots, and are only found in one great class of plants.

The roots of many plants belonging to the order *Orchidaceæ*, consist of two fleshy knobs, of which one is produced during the Summer, and is intended to bear the stalk and flower the following year, when the old one withers and dies off, and a new one begins again to grow.

There are several roots which are not referrible to any of the above forms; as that of the bird's-nest orchis, &c.

There are some plants, which, instead of deriving their nourishment directly from the earth, fix their roots into other plants, and live on their juices; they are hence called *parasitical: Ex:* mistleto, broom-rape, bird's-nest, &c.: and many lichens and fungi.

The form of the root depends very much on the nature of the soil in which it grows; even the same species of plant will have different roots, when raised in different places, and any root will become fibrous, if exposed to the action of running water.

A tree planted in a spot that is barren, or otherwise ill-suited to it, will send out roots to a considerable distance, in search of better soil, and, to effect this, will penetrate through walls, and cross dikes.

THE STEM, OR AXIS.

THE seed, when ready to grow, or *germinate*, contains the *embryo*, or future plant, in a rudimentary form, one end of which grows downwards, or towards the centre of the earth, and becomes the *root;* the other end, taking the contrary direction, extends upwards in the air, and becomes the *stem*, or axis, round which the leaves, flowers, and other organs are produced.

This tendency of the embryo to develop itself in opposite directions, is common to all *seeds* properly so called; and, as the existence of the future plant depends thereon, they are endowed with it in so powerful a degree, that no natural obstacles, and impediments artificially created by man, can entirely overcome it; or, if they are insurmountable, the seed perishes.

This subject will be further illustrated when the internal structure of plants is described; but what has been here mentioned, is necessary to explain the primary difference between the root and the stem, or axis.

The following are the principal kinds of stems:—

1. The *trunk* is the name given to the stem of timber-trees. It grows to some distance from the ground without dividing; then sends off large *branches*, in appearance like the main stem, but smaller: these again divide into still smaller, called *boughs*: the last divisions of which are *twigs*, and bear the *leaves*.

The trunk is thickest close to the ground, and the main stem, as well as the branches and boughs, diminish in size gradually to their extremities.

The outside, or the *bark*, is rough, dry, and commonly cracked; beneath this, the trunk consists of layers of *wood*, forming a solid mass. It lives a great many years, and grows in length as well as thickness.

2. The *stipe* is the name given to the stem of palm-trees, such as the date-palm, cocoa-nut tree*, areca, &c. This differs essentially in form, structure, and mode of growth, from the trunk; for it increases in length, but not in thickness, and has other characters which will be explained hereafter.

3. The *culm* is the name of the stem of grasses, reeds, rushes, and similar plants; its principal distinction is in having solid knots from which spring leaves clasping the stem, while the rest is either hollow or filled with a

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* There is a cocoa-nut palm on the right-hand side of Plate II.

light pith. Straw is the culm of wheat, barley, &c.; rushes are culms. Some plants, as the common bur-reed, and other kinds of sedges, have triangular or three-cornered culms, but in general this form of stem is round; as in the common reed, grasses, &c.

4. The name of *stem* is applied to all the other kinds which do not belong to the foregoing; hence it is of endless varieties of form, size and texture.

The stems of *shrubs* and *under-shrubs*, such as the rose-tree, lilac, myrtle, wall-flower, &c., are *woody*. The scarlet-bean, lupin, stock, and most *annual* plants, have *herbaceous* stems.

It is *smooth* in the arum, guelder-rose, valerian, periwinkle, &c.; *spinous* or *prickly* in the fullers'-teasel, rose, bramble, and in the prickly pear, &c.; *hairy* in the foxglove, geranium, bugloss, and most plants; *woolly* in the mullein; *spotted* in the hemlock, and so on.

It is generally *round*, but in mint, dead-nettle, lavender, &c., it is square; and in many others it is angular, as the triangular lobelia, St. Peter's wort, nightshade, and agrimony.

It is *winged* in the sweet and everlasting peas; that is, flattened out on opposite sides, into a thin leafy edge.

When the stem is strong enough to support itself, as is the case with most plants, it grows upright from the ground: but when it is very long and slender, or weak, it either trails on the ground, as the lesser convolvulus or bind-weed, ground-ivy, knot-grass, and many others; or it climbs up whatever will serve as a support to it, as the briony, greater bind-weed, hop, and scarlet-bean: hence these plants are called *climbing*.

Some of these cling by means of *tendrils*, which are thin stalks that twist round anything they touch, like the sweet-pea and vine; others wind their stems round and round the support, and this so closely as to suffocate the plant they grow on; as the wild honey-suckle, &c. But these latter must not be considered as parasitical, since their nourishment is not derived from the plant they thus destroy.

The stem of the common dodder is as fine as a thread; this grows for yards on the ground, forming a tangled net, and mounts up certain plants, round every part of which it entwines itself so tightly and so intricately, as to prevent the possibility of separating it. It may be seen in the Autumn, on furze and nettles especially, looking like red hair; it bears a small but beautiful flower, and has no leaf.

The ivy clings to old walls and trunks of trees by means of little claws, looking like a caterpillar's legs.

The Virginian creeper attaches itself to walls by means of a particular form of branched tendril, having at the end of each ramification a small swelling, by which it adheres closely to the building.

Many plants have no stem; or, to speak more correctly, their stem is not *developed:* the leaves of such grow from the top of the root. The primrose, leontodon, and the plantain, are examples of stemless plants; for the *stalk* which supports the flowers is not a *stem.*

There are some forms of stems which must be mentioned here, differing totally in appearance from all the above; since they are very generally mistaken for various kinds of roots, from which, however, they are as distinct as the rest, by their structure and properties.

One kind of stem assumes the *form* of a bulb, but is distinguished from the true bulb (see BUD) by being solid; this is called a *cormus;—Ex:* crocus, tulip, arum, meadow-saffron, &c.

The *tuber* is a fleshy irregular stem produced *underground*, but known to be one, by its producing buds or *eyes*, as they are called, which the true root never does; —*Ex:* potato, Jerusalem* artichoke, arrow-root, and many others.

Another kind of stem, instead of growing in the open air, creeps under-ground, and is incorrectly called a creeping root; stalks and leaves grow from it upwards, and fibrous roots downwards, from its knots or joints; —*Ex:* couch-grass, creeping barley, &c. The *root-stock*, *rhizoma*, is another species of creeping stem, thicker and more fleshy than the last. Those shoots of various plants called by gardeners, suckers, runners, offsets, stools, &c., are all modifications of stems.

It must be particularly observed that the *knots*, *joints*, or those places on stems of all kinds where a *bud* is produced, are called *nodi*, and the intermediate parts between these are termed *internodia*.

THE LEAVES.

The *leaves* are the *organs* by which the water, and other substances, sucked up from the earth by the root, are converted into proper food for the plant.

Leaves are produced at the *nodi* of the stem, or of its modifications and appendages; and never on any true *root*.

In general they are green and *herbaceous*, and consist of two parts: a *stalk*, and the flat part called the *lamina*.

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* This name is a corruption of *girar-sole*, the Italian expression for "turn to the sun." The plant in question belonging to the genus *Heli-* , or sun-flower, the name of which in many languages expresses

In some leaves the stalk is wanting, and then the lamina or leaf adheres closely to the stem, and is said to be *sessile*;—*Ex:* wood-mint, orpine, sow-thistle, catch-fly, &c.

In most leaves the two sides of the lamina vary in appearance; the upper one, that turned towards the sky, or towards the stem, being smoother and darker in colour than the under. The principal *vein*, or *midrib*, which is a continuation of the stalk, and the other veins which branch from it, project more on the lower than on the upper side, and the under side is of a lighter green, and generally more hairy or downy. The different purposes for which the leaf is intended, cause this variety.

Leaves generally grow above one another on the stem, but from opposite sides of it, or so that the points they spring from form a spiral line round it; in this case the leaves are said to be *alternate*;—*Ex:* lime-tree, apple-tree, common sorrel, and most plants. It must be particularly remarked, that adjoining leaves are *never* produced immediately above each other on the stem.

When the *internodia* between two adjacent leaves, which spring from opposite sides of the stem, are not developed, this pair of leaves will be *opposite* each other; plants which have their leaves produced in this manner in pairs, are said to have *opposite* leaves;—*Ex:* mint, gentian, mistleto, maple, &c.

When, instead of only two opposite leaves, three or more are produced from points forming a ring on the stem, they form a *whorl*, or *verticil*; such plants as have their leaves with this arrangement, are said to have *verticillate* leaves;—*Ex:* sweet wood-ruff, goose-grass, mare's tail, &c.

Verticillate leaves are considered as being produced by the non-developement of several adjacent *inter-nodia.*

One among many proofs, that this is the real origin of these different arrangements of leaves, is afforded by the *Rhododendron ponticum*, on the branches of which may often be remarked leaves both alternate and opposite.

These distinctions of the mode of growth of leaves must be particularly remarked and understood; being of great importance to the true knowledge of the structure of plants, and of their correct classification.

It is known that most parts of plants, which are not either root or stem, are leaves changed in form, texture, and colour, or *modified;* thus flowers, fruit, &c., are *modified leaves*. This will be further explained.

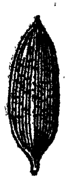
The arrangement of the *veins* of leaves must be noticed, as the figure and general appearance of the foliage depend on it; it is of two principal kinds, each of which characterizes one great class of plants.

1. A principal vein, called the *midrib*, runs through the middle of the leaf, generally dividing it into two equal parts. From the sides or base of this, smaller veins branch out, which tend towards the edge; from these spring still finer, and so on, till the whole surface is divided, as it were, into a net-work; the meshes being filled up with a green substance. The leaves of the elm, lime, and other tin

and of most shrubs and herbs, have this arrangement of veins.

The place of the midrib is sometimes supplied by several equal veins, arising from the base of the leaf. *Ex:* the vine, currant, geranium, sycamore, endive, &c.

In most leaves, the veins are not straight, but change their direction every time they branch out into others. In the oak-tribe this is not the case; the veins proceed in nearly straight lines from the midrib to the margin. This is readily observed in the common chesnut-tree, and oak.



2. In the other mode of arrangement, the veins, instead of branching out and interlacing, as just described, run side by side, without touching, from the base to the apex of the leaf; between these, in large leaves, are to be seen finer veins running across, but not forming a net-work among themselves. This structure is seen in the leaves of the grasses, tulip, lily, aloe, orchidaceæ, and palm-trees.

There are two sets of veins in leaves, one lying immediately over the other; these are not commonly distinguishable from each other, but if the leaves of many plants be steeped in water till the part which fills up the veins be dissolved, the skeleton of the leaf may be separated, and in some, as the sea-holly, the two sets of veins can be seen.

The different forms and characters of leaves are distinguished by terms with the principal of which it is necessary to be acquainted, because the various *species* of plants are often characterized by the figure of their leaves.

When the stalk bears only one lamina, the leaf is said to be *simple*;—*Ex:* the oak, lilac, cabbage, geranium, and most plants, have *simple* leaves.

When the stalk bears more than one lamina, and these are jointed to it, so that they can be separated without tearing, the leaf is said to be *compound*; each lamina, whether it have a stalk to it or not, is called a *leaflet*, and the joint is called an *articulation*. The horse-chesnut, rose-tree, ash, sweet and common pea, laburnum, clover, and a multitude of plants, have compound leaves.

Compound leaves are of different kinds.

1. *Simple-compound:* when the leaf-stalk is not divided or branched, and bears several leaflets;—*Ex:* rose, vetch, &c.

Digitate: when all the leaflets are articulated at the end of the stalk;—*Ex:* wood-sorrel has three leaflets, or its leaves are *ternate;* horse-chesnut has seven; lupin has several.

Pinnate: when the leaflets spring from the sides of the stalk, in pairs opposite each other, with, in some cases, an odd leaflet at the end, as the rose; or with a tendril, as in most vetches.

In the leaves of the agrimony, meadow-sweet, &c., the leaflets are unequal in size, and in some vetches, &c., instead of being opposite on the stalk, they are alternate on each side of it.

2. *Double-compound:* when the principal stalk of the leaf has two or more secondary stalks branching from it, which bear the leaflets. If these stalks are all at the end of the principal one, as in the sensitive plant, &c., the leaf is termed *digitate-pinnate;* and if they arise from the sides of the principal stalk, it is termed *bi-pinnate*, as in the carraway, angelica, &c.

3. *Triple-compound:* when the principal stalk has secondary stalks, and these again have others articulated with them, as in the carrot, samphire, &c.

It is the articulation of the laminæ with the stalk that essentially constitutes a compound leaf. The orange-tribe have compound leaves, yet the orange-tree has leaves with only a single lamina; but this is found to be articulated with the stalk, and, therefore, is conformable to the character of the tribe.

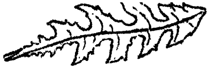
Simple leaves and the leaflets of compound leaves are said to be:—

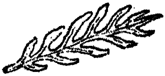
Entire, when the *margin*, or edge, is neither notched nor cut, but in one continued smooth line, whatever the general shape of the leaf may be;—*Ex:* lilac, laurel, periwinkle, oleander.

Serrated, when the edge is cut or notched like the teeth of a saw;—*Ex:* the nettle, elm, and the leaflets of the rose, and a multitude of others. If the teeth are rounded instead of sharp, the leaf is called *crenate*, as in ground-ivy, horehound, wood-betony, &c.

Sinuated, when the edge appears as if cut into roundish forms, in and out alternately, like the oak-leaf and others.

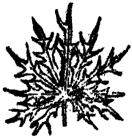
Cut, when the edge, instead of being in rounded *segments* is in sharp angular forms.





Runcinate, when the segments of a cut leaf are pointed, irregularly curved, and turned back towards the base of the leaf;—*Ex:* Leontodon, London rocket, &c.

Pinnatifid, when the margin appears as if cut very deeply, nearly or quite to the midrib, into irregular forms called *lobes*, which project out at right angles, or nearly;—*Ex:* common groundsel. When the lobes are again cut into smaller, the leaf is called *bi-pinnatifid*.



Palmate, when the general form of the leaf is roundish, but it is deeply cut;—*Ex:* several kinds of geraniums, serrated passion-flower, &c.

The two last are analogous in *simple* leaves to pinnate and digitate compound ones.

With regard to their general form, leaves and leaflets are said to be:—

Round, as those of the common sheep-rot.

Roundish, as those of the common money-wort.

Oblong, or *ovate*, as those of the brook-lime.

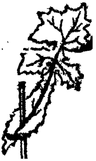
Obovate, oblong or ovate, but having one end larger than the other, as in the brook-weed, primrose, &c.

Lanceolate, when the leaf is pointed and equal at each end, but much longer than it is wide; as in the wall-flower, willows, oleander, &c.

Ovate-lanceolate, when the ends of the leaf are rounded instead of pointed.

Linear, when the leaves are very long, and so narrow as to look like a *line*, as those of many grasses, toad-rush, &c.

Triangular, as those of the common orach; *quadrangular*, as those of the black poplar, and so on.



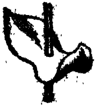
Cordate, or *Heart-shaped*, as in the lilac, lime, white water-lily. In the wood-sorrel, and clover, the leaflets are inversely heart-shaped.

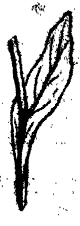
Lyrate, when the terminal lobe is larger than the side-lobes which are opposite to each other;—*Ex:* charlock, Belleisle cress, wild turnip, &c.

In the Sagittaria, buck-wheat, sorrel, and spotted arum, the leaves are *hastate*.

When there is a small point at the end of an *entire* leaf, as in the vetches, the houseleek, &c., it is said to be *mucronate*: when the lamina spreads out at the end of the stalk, like a flat umbrella, the leaf is said to be *peltate*;—*Ex:* Indian cress.

When *opposite leaves* are *sessile*, their bases often grow together, and look like one leaf, with the stem of the plant running through it; in such cases the leaves are said to be *connate*;—*Ex:* the wild teasel, soap-wort, perfoliate honey-suckle, *Chlora perfoliata*, &c.





Sometimes the bases of sessile single leaves are so decidedly united, that the stem appears to pass through their substance, as in the common hare's ear, &c.; these leaves are said to be *perfoliate*.

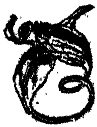
In some plants the margins of sessile leaves run down on each side of the stem, so as to seem to be of one piece with it;—*Ex:* many thistles, the mullein, &c.; these leaves are said to be *decurrent*.

In the grasses, sedges, &c., the bottom of the leaf is wrapped round the stem for some distance; these and similar leaves are said to be *sheathing*.

The leaves of plants have not in all cases flat and thin laminæ; they are in several instances thick or *fleshy*; and are called *cylindrical*, *semicylindrical*, *trilateral*, &c., according to the figure which a cross section of the lamina presents. A fleshy leaf, which is thickest in the middle, and sharp at the two edges, and pointed at the end, is said to be sword-shaped, or *ensiform*;—*Ex*: iris, aloe, &c.

Those leaves of water-plants which grow entirely under water, are generally cut into long *linear* segments; while those which float on the surface are formed like other leaves; —*Ex*: water ranunculus, featherfoil, and most others.

There are some plants with leaves very curiously formed, which cannot be referred to any of the foregoing. Of these the most singular are, the Nepenthes, an East Indian plant, the sarracenia*, &c. The stalk is hollowed out at the end into a small cup, and the *lamina* of the leaf forms a cover to it. This pitcher is generally filled with a pure water distilled into it from the plant, and insects are often found drowned in the fluid.



Generally the two halves of the leaf, one on each side of the midrib, are alike, or the leaf is *symmetrical*; but this is not the case in many, as may be seen in those of the nightshade, &c., and more obviously in the begonia, the leaves of which are irregular or oblique.

On many plants the leaves differ in form in different parts of it; thus, the *root-leaves*, or those springing from the stem just above the root, are lyrate in the Belleisle cress, while the *stem-leaves* are obovate; in the common horse-radish, the radical or root-leaves are oblong and crenate, the stem-leaves lanceolate and entire.

In the common bell-flower, the radical leaves are round, the stem-leaves linear. The former generally die off early, and are not often seen; hence beginners are surprised at the *specific* name given to it (Campanula *rotundifolia*), which means round-leaved.

On the common ivy, leaves of two forms are commonly found.

On the black oak (*Quercus nigra*), a North American tree, there are leaves of three forms, one obovate and entire, another obovate and sinuated, and the third lyrate.

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* There is a figure of this plant on the right-hand corner of Plate I.

A South American plant, called, on that account, Ludia *heterophylla*, or *irregular-leaved*, has six different forms of leaves; and many other examples might be given.

Many plants have no leaves at all, their office being performed by some other part peculiarly formed for that purpose. It requires accurate knowledge of the subject, to be able to understand whether such plants have leaves or not.

The stem of the cactus, or prickly pear, swells out between the *nodi*, into ovate fleshy prickly masses, which look like leaves; and hence, these plants are erroneously supposed to bear their flowers on the edges of their leaves; though, in fact, they are leafless. The common dodder (Cuscuta europæa), has been already mentioned as a leafless plant.

In the Lathyrus nissolia, an English plant, the stalk is flattened out, and looks like the leaf of a grass, but there is no real *lamina*.

In another rare plant of the same tribe (Lathyrus aphaca), the place of the leaves is supplied by large *stipulæ*, an appendage to the leaf which will be presently described.

In some plants, the leaves are only partially produced, and look like scales on the stem, as in the common broom-rape, the bird's-nest orchis, and many others.

At the foot of the stalk of the leaves of many plants, are found small leafy appendages called *stipulæ;* which will be best understood by examples and observation.

In the common dog-rose the stipulæ grow, for their whole length, along the sides of the stalk, one on each side of it. In the common rhubarb, the stipulæ form a sheath round the

Those of the sweet and everlasting pea, and other plants of that tribe, are shaped like half the head of an arrow.

Those of the common meadow-sweet are roundish, of the clover oval, of the sweet violet *lanceolate*, and of the apple and pear *linear*.

The stipulæ of the violet and heartsease are much larger than the leaf itself, which is oblong, simple, and slightly serrated, the stipulæ being pinnatifid.

Stipulæ are commonly *herbaceous* in texture, but in the polygonum, and many other plants, they are *membranous*. From the mode of their growth in some plants, as in the coffee-tree, where they are produced between opposite leaves on the stem, they are considered as accessory leaves, but little is known about them.

They are regarded as part of the leaf in botanical descriptions. Plants which possess them, are said to have *stipulate* leaves; those which have them not, are described as having *exstipulate* leaves.

The leaves of most plants possess a power of motion, which is the effect of what is termed *irritability*, or vitality; and is, consequently, independent of any mechanical force applied to them.

The most general exhibition of this motion is shown in the change of position of leaves during the night, and has been termed by Linnæus, the "sleep of plants;" it is easily observed in compound leaves.

The leaflets of those of the acacia, and other plants, droop on the approach of darkness, and rise up with the returning light; in the bladder-senna the reverse takes place. But a more striking instance of voluntary motion is shown by the leaves of a Bengal plant, called *Hedysarum gyrans;* the two lateral leaflets are in almost perpetual action, turning abruptly and irregularly round on their stalks; sometimes only one moves, while the other remains at rest; the terminal leaflet moves up and down.

The irritability of the double-compound leaves of the *Mimosa pudica*, or sensitive plant, is still more apparent. On the lightest touch, the leaflets close themselves up in pairs; if the blows be repeated, the secondary stalks fold upon the principal one, the whole leaf droops as if dying, and only resumes its natural position after some time has elapsed.

Here, though the immediate cause of the motion is mechanical, yet the mode in which the effect shows itself, results from the vitality of the plant.

The dionæa, a North American plant, has leaves which can close together, by turning on the midrib as a hinge, and are covered with stiff prickly hairs. No sooner does an insect alight on these, than the two halves fold together, and kill it. This plant is hence named Venus' fly-trap*.

The leaves of the sun-dew, so common on moist heaths in England, possess the same property in a less degree, but small flies may be often seen dead in them.

The leaves of many plants are also affected by the application of noxious vapours, or by mineral and other poisons, which is a further proof of irritability.

But though there are few plants which manifest irritability in so great a degree as those above-mentioned, yet all have the power of turning their leaves, to seek the light which is necessary to their growth, if placed in too shady a situation.

The leaves of those placed in a dark room, or in a cellar, will not only turn their upper-sides towards the window, but their stalks will grow longer than they ordinarily do, in order to approach as near as possible to it. This has been observed by every one, of common geraniums, in such situations.

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* There is a figure of this plant in the right-hand corner of Plate I.

The leaves of all trees and shrubs, after a certain time, fall off, and are again renewed. In cold climates this "fall of the leaf" generally takes place on the approach of Winter, and as, during the rigour of that season, the plant is in a torpid state, the new leaves do not appear till the return of warmth with the Spring.

Those plants, the leaves of which do not die off all together, but are being successively renewed, so that they are never leafless, are called evergreens;—*Ex:* juniper, laurel, fir, periwinkle, holly, &c.

Many plants are evergreens in warmer climates, that shed their leaves with us in winter; as the orange, the oleander, and others. It is found that here, those alone are evergreens which have particular fluids formed in their bark or *skin*, which defend them from the effects of cold; as fir, pines, larches, &c.

It is, therefore, most probable that severity of weather is the cause of the general shedding of their foliage among our forest-trees and shrubs; but all trees, in every climate, lose their leaves and renew them.

When they first grow, leaves are continuous, or in one piece with the stem; but an *articulation* is generally formed at their junction, and when this is completed, the leaf apparently decays and falls.

THE BUD.

Buds consist of a collection of rudiments of leaves surrounding a central *vital point*. When this point grows, or *develops upwards*, in the form of a *stem* or axis bearing these leaves, the bud is called a *leaf-bud;* when the bud produces one or more flowers, instead of leaves, it is called a *flower-bud.*

Buds are *always* produced in the axilla of a previous leaf, when not *accidental* or irregular.

Leaf-buds appear, in this situation, on trees and shrubs, soon after the leaves; but they are little seen till Autumn. They grow but slowly during the Winter, the vegetation of the plant being in a great measure stopped during that season; on the return of Spring the buds advance rapidly; the leaves which compose them open out as the central stem or axis lengthens, and by the end of the Summer a green twig or young branch is formed, which produces fresh buds from the *axillæ* of its leaves in turn. In succeeding years the original bud becomes a branch with numerous ramifications, all owing their existence to the repetition of this same process.

In some shrubs and trees, the buds, instead of appearing in the open angle of the leaf-stalk and stem, are formed in the substance of the base of the former, which swells out in consequence, and hence the bud is not visible till the old leaf falls. This may be observed in the common plane, &c.

Hence, as the branches of trees originally sprang from buds, and as these are always formed in the axillæ of leaves, a plant which bears *opposite* leaves will have its branches and boughs *opposite;* and one which has *alternate* leaves will have its branches so; but this symmetry is constantly deranged by accidents in trees and shrubs. Birds and other animals destroy buds and young shoots, and storms break off boughs and branches.

Leaf-buds are generally covered with two or more scales, thicker and tougher than the other leaves; these are called *perules*, and are intended to defend the young enclosed leaves from the cold and damp.

In severe climates, they are often covered with a resinous coating, and lined inwardly with a downy substance; but in warmer countries, this defence not being so necessary, the perules are little different from the usual texture of leaves; they drop off when the bud expands.

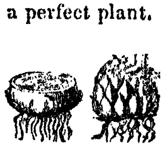
The thick clammy bud of the horse-chestnut furnishes a good example of a perule, and, indeed, of a bud generally.

Leaf-buds generally contain only the rudiment of one axis or stem, but those of pine, fir, and other trees of that kind, contain several, each enclosed in its own proper perule.

When the plant has no stem, the buds are produced in the axillæ of the root-leaves, as in the daisy, primrose, &c.

The *bulb* is essentially a bud, but differs from ordinary ones in not producing a stem, and in being formed at, or just under, the surface of the ground. It consists of the fleshy bases of the future leaves; and new bulbs, called by gardeners *cloves*, are formed in the *axillæ* of these, the new bulbs by their growth destroy the parent bulb, and thus continue and multiply the species, since each of them is capable of producing a perfect plant.

Bulbs are of two kinds: the *tunicated*, consisting of concentric rings, being the bases of the leaves quite surrounding the centre:—*Ex:* Narcissus, onion, hyacinth, &c.



The other species of bulb consists of separate *imbricated* scales, each of which expands into a leaf; these, therefore, are not sheathing, as those of the other kind; —*Ex:* garlic, squill, lily, &c.

Irregular or *accidental buds* are found in other parts of plants, besides the true ones in the axillæ of leaves;

thus, in some species of garlic, they are produced in the place of flowers in the flower-bud.

Another kind of bud, resembling a bulb, is produced on the roots of some plants; and the spots called eyes, in the potato, are rudimentary buds buried in the substance of this form of stem by its irregular growth.

Some plants produce a kind of bud in its usual situation, but this, instead of growing into a branch with leaves, falls off from the parent stem when it is perfected, and takes root in the ground like a seed;—*Ex:* coral-wort, bulbous fumitory, and several foreign lilies and aloes.

Some plants, as the marsh malaxis, the Bryophyllum, &c., produce accidental leaf-buds on the margins of their leaves.

The subject of buds will be further explained when the flower-bud is described.

It is found that the young leaves are constantly folded up in the bud in the same way in the same species of plants, and there are many different modes of this arrangement; this is termed the *vernation* or *foliation* of the plant.

OF HAIRS AND GLANDS.

The herbaceous parts of most plants have hairs on them, in a greater or less degree; in some, as the marsh-mallow, the enchanters' nightshade, cabbage, &c., they are hardly perceivable.

Those plants, generally speaking, most abound with them, which grow on a dry soil, as common gromwell, bugloss, &c., or on high mountains, or those of hot climates.

On some plants the hairs are long, but scattered; on others they are short and thick; on some, as the common borage, comfrey, viper's bugloss, &c., they are stiff, and on some common cud-weeds and mulleins, they resemble cotton in appearance and touch.

They are found to be of very different forms when examined in a microscope.

The most curious example of hairs is shown on the cobweb houseleek, where they look as if spun from leaf to leaf, like the web of a spider.

Physiologically considered, hairs are of two kinds:—

Those which are intended, apparently, to regulate the escape or evaporation of moisture from the surface of the plant, are called *lymphatic*, and are the most common; and for this reason are very abundant on plants growing in exposed situations.

The other kind are called *secreting* hairs, and are a species of *glands* or receptacles of fluids, peculiar to certain plants; such are those of the common nettle, which, when touched, penetrate the skin, the pressure causing a colourless acrid juice, contained in a minute bag at their base, to be forced through them into the wound; it is this juice which produces the smarting pain.

The GLANDS of plants are very various in appearance, form, and situation; their use and nature are not well understood.

In the myrtle, orange, St. John's wort, and many others, they appear as small transparent dots on the leaves, or other green parts, when these are held up to the light.

On the moss-rose they are *secreting* hairs, with a little round coloured globe at their points, and feel clammy.

The under-side of the leaves of many plants are covered with very minute glands, like beads; these are seldom visible to the naked eye.

In short, their various forms can only be learnt by observation, and by consulting books on the subject.

It may be remarked that the perfume of the flowers and leaves of plants arises from secretions from glands.

The thorns and prickles of plants are *hairs* grown thick and strong; but this is to be understood of such only as can be separated from the plant without laceration, as can be done with those of the stems of roses and briers, gooseberry-bushes, &c.

Those which cannot be so removed, owe their origin to other causes; of this latter kind are the spines of furze, blackthorn, and many others; most of these are produced from buds not developed in the usual manner.

THE FLOWER.

The flower is an organ composed of several distinct parts; and generates and matures the seed, by which the plant is enabled to continue its species.

Flowers are produced from buds, which, like *leaf-buds*, are formed in the *axillæ* of leaves, called *bracteæ*. These differ commonly from the ordinary leaves of the plant, either in size, colour, or form; but observation and knowledge can alone enable the botanist to distinguish in all cases true bracteæ from leaves; they will be further explained.

Flower-buds consist of an assemblage of rudimentary leaves surrounding a central point, which grows into an axis, called the *flower-stalk*, or peduncle; this often grows for some length before any of the leaves *expand*, or before the bud *opens*.

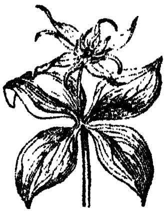
These rudimentary leaves have the power of producing in their axillæ other buds, with their enclosed leaves and axes.

If these secondary buds are not *produced* or *developed*, the principal one brings forth one flower only, which is always at the end of the flower-stalk, because the axis does not, naturally, grow longer, after the inmost set of leaves, which form the flower, begin to expand;—*Ex:* pæony, tulip, &c.

The manner in which the flowers are arranged on a plant, according as the various buds are produced and expanded, is called the *inflorescence,* or mode of flowering.

In order to understand this, the beginner must constantly remember, that *all* regular beds are formed in the axillæ of leaves, or bracteæ; and that the centre of a bud grows into an axis or stalk, bearing the leaves enclosed in that bud, the innermost of which constitute the flower; while other buds, giving birth to new stalks, leaves, and flowers, may, or may not, be produced in the axillæ of the outermost, as they are unfolded on the original stalk.

The principal forms of inflorescence are:—

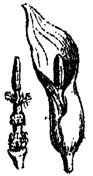


When the principal stem of the plant produces a flower-bud, and then ceases to grow, the flower is *solitary* and *terminal;—Ex:* pæony, and pheasant's-eye, herb Paris, &c.

When one flower-bud is produced in the axillæ of a leaf, and the principal stem continues to grow past it, the flower is said to be *solitary* and *axillary;—Ex:* yellow pimpernel, periwinkle, &c.

When all the buds of a newly-formed axis unfold into flowers, each having a stalk, the inflorescence is called a *raceme;—Ex:* enchanters' nightshade, water-betony, brook-weed, hyacinth, shepherd's purse, &c.

If, in the same circumstances, the flowers are *sessile,* or very nearly so, they form a *spike;—Ex* lavender, corn, saintfoin, agrimony, dyers' weed, plantain, butterfly orchis, mullein, yellow cotyledon, &c



The principal axis of a spike and its derivatives is also called a *rachis*.

There are a great variety of *spikes*, according as the flowers are *alternate* or *verticillate*, on the principal axis, and according as they are distant or crowded on it; if they produce secondary spikes, with a similar arrangement, the principal one is said to be *compound*.

A spike, the sessile flowers of which are very crowded, the principal axis thick and fleshy, and enveloped in a large coloured bractea, is called a *spadix*, and this last a *spathe;* this is peculiar to the arum, calla, dracontium, and many palms.

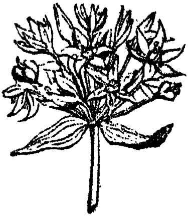
When the bracteæ on the principal stalk are close, and overlap one another, or are *imbricated*, with the flowers sessile in their axillæ, the spike is termed an *amentum*, or *catkin*, and the peduncle is always *articulated* with the main stem of the plant;—*Ex:* willow, oak, birch, poplar, walnut, beech, and many other trees.

Catkins are generally *pendent*, or hang down; the spike, in general, is erect.

When a principal flower-bud produces others without lengthening its stalk, a *head*, or *capitule*, is formed; —*Ex:* Scabious, sheep's-bit, clover, kidney vetch, &c.

One form of head must be particularly noticed, from its being the characteristic of three large orders of plants, often, though improperly, called *compound flowers*, because the head resembles a single flower in its appearance.

In this inflorescence, the top of the flower-stalk is swollen out into a sort of cushion, called a *receptacle*, on which are crowded a multitude of small sessile flowers, called *florets*, which will be explained in another place; these are all surrounded by the outer bracteæ, enclosing the bud, which are imbricated, and form what is called an *involucrum*;—*Ex:* Leontodon, daisy, aster, sun-flower, thistle, hawk-weed, artichoke, &c.



When the principal axis is but little lengthened after the opening of the bud, and the other flowers it contained have stalks, an *umbel* is formed; this is either *simple* or *compound*.

A *simple umbel* has the stalks springing from the same part of the principal one, and each bears but one flower;—*Ex:* flowering rush, agapanthus, geranium, pelargonium, wild garlic, &c.

In the *compound umbel* the stalks of the secondary buds bear smaller umbels, into which these open.

The compound umbel is the characteristic of a very large tribe of plants, hence called *Umbellaceæ;* of which the carrot, parsnep, celery, parsley, hemlock, coriander, &c., are familiar to every one.

A *corymb* is a raceme, the lower flowers of which have long stalks, and the upper short ones, so that the flowers are nearly on one level;—*Ex:* star of Bethlehem, lady's-smock, common hawthorn or May, yarrow or milfoil, wild service-tree, &c.

All the foregoing forms of inflorescence are considered as modifications of the spike or raceme, the rachis being *undeveloped*.

A *panicle* is a raceme, the flower-buds of which have, in growing, produced others, and, consequently, the stalks are branched;—*Ex:* oats, and many grasses, cineraria, &c., wood-rush, yucca and agave, meadow-sweet, &c.

When the middle branches of a panicle are longer than the rest it is called a *thyrsus; Ex:* lilac, privet, horse-chestnut, &c.

A *cyme* resembles an umbel, in having the flowers level at the top, but the stalks spring from different points of the principal one;—*Ex:* elder, oleander, &c.

There is one variety of the cyme, in which the flowers are produced in the axillæ of *opposite* leaves; and being crowded, they appear to form a *whorl* of flowers round the principal stem of the plant; this is one characteristic of a large tribe of plants, of which the mint, thyme, sage, monarda, dead-nettle, &c., are well-known examples.

In the vine, the rachis, or principle axis of inflorescence, frequently produces no flower-buds at all, but becomes lengthened, and acquires the property of turning round any neighbouring body, and thus assisting to support the plant.

This *false tendril* must be carefully distinguished from the true one, which is always a prolongation of the midrib of a leaf; whereas the one in question springs from the axilla of a leaf, and thus indicates its origin.

It is this kind of discrimination between the various forms the different organs of plants assume, that is so important to the advancement and knowledge of botany, and to which the attention of the rational student cannot be too frequently called.

OF BRACTEÆ AND THE INVOLUCRUM.

The leaf in the axilla of which a flower-bud is produced, is called a bractea, as has been already mentioned.

The most remarkable sort of bractea is that called a *spathe*, which has been noticed in describing the species of inflorescence termed a spadix.

Bracteæ vary greatly in appearance; most usually they are green and herbaceous, like other leaves; but the spathe is coloured, and so are the four bracteæ which surround the true flower of the hydrangea. Common observers take these for the flower itself, which is small, and escapes observation.

The spathe, or bractea, of many plants is membranous, as the narcissus, the wild garlic, flowering rush, &c.

The *outer* set of leaves composing a flower-bud are generally *alternate*, and, as the axis grows, they open singly on different parts of it; they are also bracteæ, because other *flower-buds* are formed in their *axillæ*, as has been explained; but when no such secondary buds expand, these bracteæ appear like small leaves on the principal flower-stalk, as may be seen in the sow-thistle, buttercup, corn-marigold, centaury, ox-eye, and many others.

The presence of bracteæ on the flower-stalk is so general in plants, that their absence in one large order (Cruciaceæ) is a striking and important characteristic of it; and indicates a remarkable deviation from the usual laws of floral developement. The learner may refer to shepherd's-purse, wallflower, stocks, wild cabbage, &c.

When two or more bracteæ, instead of appearing singly and alternately on the principal flower-stalk, are opposite or verticillate, they form an *involucrum*.

There is an involucrum at the point where the stalks of the umbel branch out, in many umbelliferous plants, as in the wild carrot, samphire, water-parsnep, &c. (See figures of umbel.)

The large bracteæ immediately below the flowers of the wood-anemone afford a good example of an involucrum.

The head of composite or compound flowers, as they are commonly called, is always surrounded by an involucrum of many leaves, which are *imbricated*, as was before stated;—*Ex:* dahlia, aster, marigold, &c.

Each floret in the heads of many genera of Compositæ has a chaffy bractea growing at its base out of the receptacle; this form of bractea is called a *palea*, and the receptacle is in that case said to be *paleaceous*;—*Ex:* yarrow, burweed, thistle, &c.

The part of the plant called the artichoke (Cynara scolymus) which is eaten, is the base of the leaves of the involucrum, and the receptacle of a flower, like a thistle, of the order Compositæ; the paleæ of the receptacle form what is vulgarly called the *choke*.

Another remarkable form assumed by bracteæ, is the *Cupule;* or the cup of the acorn, the fruit of the oak, &c. In the filbert the cupule preserves the limbs of the separate bracteæ distinct, though these are united at the base: in the beech-nut the bracteæ form a tough shell nearly enclosing the fruit: the berry of the yew is a bractea entirely altered in texture, enclosing the *seed*. The *cones* of the fir-tribe are formed of imbricated hardened bracteæ.

The *inner* elementary leaves of the flower-bud are always whorled, or verticillate; and constitute, when expanded, what is commonly called the flower; as soon as these begin to open, the axis, which has hitherto formed the flower-stalk, ceases to grow, and the top of the stalk, or part where these leaves are joined to it, is called the *receptacle*.

There are rarely less than two, and commonly four, whorls or verticils of these inner leaves.

The flower, properly speaking, consists of two or more whorls of elementary leaves, which differ in form and appearance from all others, and are called *sexual apparatus*, because, by their means, the seed of the plant is formed and matured, so as to become capable of growing: these are commonly surrounded by one or more whorls of leaves differing from the inner set, and unlike other leaves, which are called *floral envelopes*, or *perianth;* but these envelopes, as will be shown, are not essential to the flower.

THE CALYX.

The calyx is the outer set of the *floral envelopes*, when there are more than one verticil of these.

It is composed of two, at least, but usually more leaves, called *sepals**, these are generally herbaceous; —*Ex:* pink, rose, wall-flower, and most flowers.

When the sepals are distinct, or separate from each other, the calyx is said to be *polysepalous*. The outer green covering of the bud of the flax, or rose, is the calyx; and when the flowers open, this is found to consist of five different species, or sepals, connected by their base with the peduncle.

In the common poppy, and yellow balsam, or touch-me-not, there are only two sepals; there are three to the spider-wort, orchis, &c.; four to the wall-flower and radish; six to the common barberry; and five or ten in most flowers.

But in many plants the sepals are joined together, more or less, by their edges, so as to form one piece in appearance; in this case the calyx is said to be *monosepalous;—Ex:* pink, pea, henbane, Convolvulus, &c.

The sepals are seldom joined for their whole length; the part where they are united is called the *tube*, and the separate ends the *teeth* or *segments;* such calyces are commonly, though improperly, described as being *cut* into so many segments, or as being toothed. The partial cohesion of the segments of the calyx in the genus œnothera is characteristic of it.

The sepals of the escholtzia and eucalyptus are so firmly united, that in order to blow, the flower detaches the calyx all round its base, and pushes it off at top in the form of a little extinguisher. The learner should remark and remember this fact.

The calyx is said to be *regular* when all the sepals are alike in size and form;—*Ex:* strawberry, borage, rose, cinquefoil, flax, mint, ground-ivy, &c.

It is called *irregular* when the sepals are *unlike* in size or form;—*Ex:* thyme, foxglove, violet, &c.

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* The word sepal has no derivation, but was invented by botanists to distinguish the parts of the calyx from those of the corolla.

In many plants the calyx has one of its sepals hollowed out into a long thin tube, like a spur, and is hence said to be *spurred*. In pelargoniums this spur grows to the stalk, so as not to be readily perceivable; but it is very distinct in the larkspur, tropæolum*, or Indian cress, &c.

The calyx is said to be *deciduous*, when it dies off either soon after, or immediately on the opening of it, as in the escholtzia, poppy, &c.; or before the fruit begins to ripen, as in the ranunculus, and most flowers.

Polysepalous calyces are *generally* deciduous.

It is said to be *persistent* when it continues to live after the rest of the flower withers, and either encloses, or else forms part of the fruit, as in the common hound's tongue, rose, apple, lavatera, and a multitude of others.

Monosepalous calyces are *generally* persistent.

Sometimes the calyx is not herbaceous in texture; in this case it is said to be *coloured;—Ex:* fuchsia, tropæolum, ranunculus, monk's-hood, pomegranate, trollius, and many others.

Care must be taken not to confound the true calyx, which only belongs to one flower or sexual apparatus, with bracteæ, involucra, spathes, &c., which surround and accompany several.

The learner will be occasionally puzzled to decide whether a floral envelope be a calyx or a corolla, especially if it be coloured. In the common globe flower, or *trollius*, the five large yellow leaves forming the flower are a *calyx*, and the *corolla* will be found within, consisting of five little rolled-up leaves surrounding the stamens. The common mash-marygold (*Caltha palustris*) has no corolla, the flower consisting only of five sepals. And invariably when there is only one verticil of floral envelopes, it is considered as a calyx; if there be two, the *outer* one is the calyx and the *inner* the corolla, whatever may be the size, colour, or form of the modified leaves composing each whorl. There are two, *apparent* exceptions to this law, which must be explained; there is no perceptible calyx to the flowers of many of the umbelliferous tribe, such as fools' parsley, angelica, fennel, burnet saxifrage, earth-nut, and many others; and yet the

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* This plant is commonly, but wrongly, called the nasturtium, which is the name of the common-cress.

five white floral leaves are considered as a corolla, from *analogy*. In the other plants of that tribe there is a distinct five-toothed calyx; sometimes, however, the segments are very minute, and hardly perceptible, and in the genera above enumerated they are altogether wanting; still, however, there is a thickened herbaceous margin, or cup, enclosing the petals, and this cup is considered as the rudiments of a calyx, the white floral leaves are therefore justly regarded as a corolla.

Again, there is hardly any calyx of the usual form to the small florets in the heads of the order Compositæ, but as some genera have a distinct calyx, and as there are the rudiments of segments in most, the coloured tabular floret is to be regarded as a corolla.

THE COROLLA.

The next whorl of leaves within the calyx, is called the corolla; this is the part of the flower which is so attractive, from its fragrance and beauty, it being found of every shade and variety of colour, except black; it differs in texture from the calyx and leaves, being more delicate, and the nerves not so thick and strongly marked; this kind of texture is called *petaloid*.

The separate leaves of the corolla are called *petals*, and these, like the sepals of the calyx, are either distinct, when the corolla is said to be *polypetalous*, as in the ranunculus, wall-flower, pink, rose, &c.; or are united by their edges, in a greater or less degree, in which case the corolla is called *monopetalous*, as in the convolvulus, honey-suckle, mullein, bugloss, &c., and the little flowers, or florets, which form the heads of composite flowers.

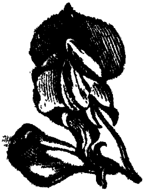
Like the calyx, the corolla is either *regular* or *irregular*; but this latter admits of a much greater variety of form than the former.

When all the petals are alike in size and form, whatever that may be, or when the corolla appears symmetrical, it is called regular:—*Ex:* corn, cockle, flax, strawberry, St. John's-wort, columbine, bell-flower, geranium, &c.

The petals are unequal, or unlike each other, and therefore the corolla is *irregular* in the tropæolum, pelargonium, violet, orchis, mint, &c.

The corolla is called *papilionaceous* (butterfly-like), when it consists of five petals of particular forms, of which the uppermost, or external one, is generally largest, and turned back, this is called the *standard*, or *vexillum;* the two next are alike, but differ from the first; they are placed so as to have their faces turned towards each other; they are called the *wings*, or *alæ;* the two lowermost are also alike, but differ from the rest; they are generally united by their lower edge, and are so shaped as to form a figure resembling the keel of a boat, and are hence together called the *keel*, or *carina.*

This very peculiar corolla, though it varies much in appearance, is always easily recognised; it is a characteristic of the very large order of plants, called *Leguminaceæ*, of which the sweet-pea, broom, bean, lupin, vetch, clover, saintfoin, robinia, &c., are examples.



In the corolla of many plants, one or more of the petals are spurred, as in the violet, orchis, columbine, &c.

Other forms of irregular polypetalous corollas are too numerous to admit of description, and are simply called irregular; of these our own wild flowers afford examples, in the monk's-hood, yellow-balsam, larkspur, lolygala, fumitory, lobelia, and others.

Of foreign plants, the varieties of form are endless, as may be seen in the schizanthus, rhinanthes, lopezia, strelitzia, cactus, amphilochia, grevillea, &c.

The flower of one tribe of plants, the Orchidaceæ, requires notice from its peculiarity; the calyx and corolla consist of three pieces each, and one of those forming the latter, differs very much in size and form from the other two; it is called the *labellum* (or little lip), and is often spurred.

In many species, this corolla resembles an insect, and hence, they have received the name of *bee*, fly, spider, butterfly, frog, lizard orchises; the whole tribe is very remarkable on many accounts, and will be again referred to.

The lower part of the single petal of a corolla by which it is fixed to the receptacle, is called the *claw*, it represents the stalk of the leaf; the broad expanded part, answering to the lamina, is called the *limb*. In the rose, the claw is very short; in the pink it is very long. The margin of the petal is smooth in the ranunculus, strawberry, &c.; crenated in the pink, flax; fringed with hairs in the rue, &c.; cut or notched in mignonette, or reseda; divided nearly into two lobes in chickweed and stitchwort.

Each petal of the common bog-bean has a fringe, or beard, on the limb, which gives a very singular appearance to this beautiful flower.

It must be noticed, that the number of petals, as well as sepals, is commonly the same in the same tribe of plants.

The corolla of the enchanter's nightshade has two petals; the water-plantain, three; œnothera, chelidonium, and poppy, four.

There is one very large order of plants which have four petals, arranged so as to look like a cross; and are hence called Cruciferæ, 'cross-bearing.' The radish, charlock, mustard, cabbage, coral-wort, cardamine, wall-flower, stock, &c., are cruciferous plants.

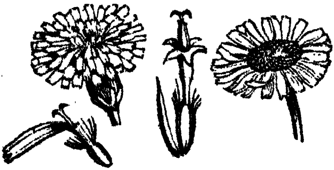
In most plants, however, the number of petals is five or ten, as the wild rose, soap-wort, flax, hemlock, and numberless others.

Monopetalous corollas are either *regular*, produced by the union of equal petals; or *irregular*, composed of unequal petals. The part formed by the united margins, is called the *tube;* and the part consisting of the distinct portions of the petals, is called the *limb*.

In the common nightshade, cyclamen, and many others, the limb is turned back. In the periwinkle, oleander, &c., the limb appears twisted.

The projecting parts of the limb of an irregular corolla, are called *lips*. The acanthus and many others have but one lip. When one lip is very long and narrow compared to the length of the tube, the corolla is called *ligulate*, or strap-shaped.

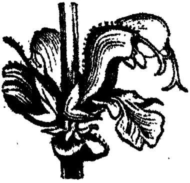
The outer part of the *heads* of many composite flowers is formed of the ligulate corollas of the exterior florets; as in the daisy, aster, sunflower, &c.; this part of the head is called the *ray*, the central part is composed of florets, with regular corollas, and is commonly of a different colour to the ray; this central part is called the *disk*.



In the hawk-weed, leontodon, sow-thistle, &c., all the florets are ligulate, and the strap is toothed at the end.

A corolla with two lips is called *bilabiate*, and these are always placed one above the other, or behind and before, with respect to the stalk, stem, or axis, and never right and left.

When the two lips present an appearance like the mouth of an animal, the corolla is called *ringent*.



There is a large tribe of plants called Labiatæ, which have irregular monopetalous corollas, and these generally *bilabiate* and *ringent*, of which the splendid salvia, dead-nettle, monarda, mint, &c., are examples.

When the mouth of the tube is partly or entirely closed by the lower lip, the corolla is sometimes called *personate;* as the snapdragon, cow wheat, toad-flax, rattle, &c.

The lips of monopetalous corollas are cut, notched, or lobed in various modes, which are characters of different species of plants.

The upper lip is often *vaulted*, or resembles a helmet, as in the common scull-cap, slough-heal, eye-bright. &c.

In the ground ivy, the upper lip is *bifid*, the lower *trifid*, or three-cleft.

In the common toad-flax which grows on old walls, the linaria so frequent in hedges, and the snap-dragon, the lower lip is *spurred*, and the whole flower is very curiously formed, something like a frog or tadpole.

In the calceolaria, a foreign plant, now common in our gardens, the lower lip is shaped like a little bag, with a narrow mouth; a similar form is found in a rare and beautiful English plant of the orchis tribe, called lady's slipper (Cypripedium calceolus).

The petals of all corollas are placed alternately with the sepals of the calyx; that is, the centre of a petal or a sepal is opposite the division between two sepals or petals; this is the result of the law by which all leaves are developed alternately round an axis; two adjoining leaves never being immediately over each other.

When this is not the case, but the petals are opposite the sepals, an intermediate whorl of leaves is considered to have been abortive, or to have remained undeveloped. It is essential to bear this law in mind, in order to understand the true nature of the floral envelopes of many flowers.

In many plants there is only one whorl of leaves round the sexual apparatus, or only one floral envelope; this is considered as a calyx, whatever may be its colour or texture. It is often called by botanists, a *perianth;* it resembles a corolla in the tulip, marvel of Peru, &c.

The flower of the common wild corn-poppy must not be considered as a perianth, it being strictly a corolla; the calyx, which is seen in the bud, having fallen when it opened. The calyx of the escholtzia, a plant belonging to the same tribe as the poppy, detaches itself from the flower-stalk when the bud opens, and is pushed off over the corolla in the form of an extinguisher.

In the star of Bethlehem, which has a single perianth, the outside of it is herbaceous like a calyx, and the inside is petaloid like a corolla; showing the gradation from the leafy to the more delicate texture; the same may be seen in many other flowers.

In the grasses, and plants resembling them, the floral envelopes are not calyx and corolla, but bracteæ. The two outer ones are called *glumes*, the two inner *paleæ*, and two within these, at the base of the seed-vessel, *scales*.

They are membranous or chaffy in texture, yet it is not on this account that they rank as bracteæ; but because they are in most cases not developed in *verticils*, but *alternately* on the axis of inflorescence.

The manner in which the calyx and corolla are folded before the flower opens, is called the *æstivation* of the plant, and is important to be observed; it is to the flower-bud what the *vernation* is to the leaf-bud.

The æstivation, or vernation, is said to be—

Imbricated, when the flat edges of the laminæ overlap those beneath them, as the tiles on a roof.

Valvate, when the laminæ are applied to each other by their edges only, without any overlapping.

Contorted, when the laminæ are oblique, or unsymmetrical in figure, and are imbricated; the common periwinkle is a good example of contorted æstivation.

There are several other terms which must be learnt by study; they mostly explain themselves, but are not frequently used: the above are those which are of most common occurrence, and are essential.

The terms of æstivation also apply to the stamens; and it frequently, if not usually, happens that the calyx, corolla, and stamens of the same flower differ in the mode of their æstivation. Thus the calyx of the fuchsia, œnothera, &c., is valvate, while its corolla is contorted. The calyx of papilionaceous flowers is monosepalous, or valvate, while the corolla is said to be *vexillary*. The calyx of the poppy is valvate, while its corolla is wrinkled, or *corrugated*.

The size of the flower, like that of the leaves, does not bear any regular proportion to that of the plant. In South America, there is a climbing plant, the flowers of which are four feet in circumference, and the Indian children put them on their heads like hats.

As examples of other large flowers, the genera datura, aristolochia, nelumbium, and those of the order Liliaceæ, may be mentioned for herbaceous plants; and magnolia, lecythis, bertholletia, and gustavia, for timber-trees.

The common annual sun-flower, it must be remembered, is not a single flower, but a collection of many hundreds; it is, we believe, the largest *head* of flowers in the order to which it belongs.

THE STAMENS.

The whorl of leaves within the corolla are commonly totally unlike all others; they form one of the two essential parts which constitute the true flower, and are called the *stamens*, or male organs of the plant.

The usual form of each stamen, or modified leaf, is a small hollow case or sack, called the *anther*, supported on a thin delicate support, called the *filament*. The anther is filled with a multitude of excessively minute globules, called the *pollen*, which contain a fluid. At a certain period, in some plants before, in most after, the expansion of the flower, the anther opens, and the pollen is shed on the other part, hereafter described, called the pistil. It is known that this process is necessary to the perfecting of the seed.

The usual form of the stamens is very plainly seen in the common white lily.

The anther is of very various forms; the most usual resembles that of a grain of corn, only much smaller; it has a crease or line down it as the grain has, at which the anther opens when bursting; this line is generally turned inwards, towards the axis of the flower; but in the common ranunculus, the cucumber, iris, passion-flower, and some other plants, it is turned *outwards;* the reason of this singularity in structure is unknown.

Uncommon forms of the anther may be observed in the following plants; tuberous commelina, larger cerinthe, Virginian spider-wort, evening primrose, *Galeopsis ladanum*, common scull-cap, chironia, &c. Two of the anthers of the heart's-ease have a long appendage, which is concealed within the spur.

The anther is generally fixed immoveably to the filament in different ways; but in most of the grasses, and many other plants, it is attached by its middle, and the filament being very thin, it is moved by the slightest air. The light powdery appearance of the spikes of a field of grass when in flower, is produced by the anthers of the plant, and must have been remarked by every one.

The stamens are usually separate, but in many plants they unite in various ways.

When the filaments are joined together so as to form part of a tube, the plant is said to be *monadelphous*, as in the hollyhock, geranium, mallow, &c.

If some are united, and others separate, or if they are united in two or more parcels, they are said to be *diadelphous*, or *polyadelphous*, as in the pea, lupin, St. John's-wort, &c.

In some plants, the anthers lie close to one another, and appear to form a tube round the pistil (see the next section). but they are not really joined;

this may be seen in common borage, and in the common nightshade, potato, &c.

But in some tribes of plants, as Compositæ and Lobeliaceæ, &c., the anthers are really joined together, and are termed *syngenesious.* This will be found to be the case in the florets of the heads of the former orders of these plants, if examined with a magnifying glass.

The most singular structure of the stamens is presented by the Orchis tribe, and is termed *gynandrous*, Instead of there being a distinct verticil of separate stamens surrounding the pistil, as is the case in all other plants, two of the three stamens proper to the class are abortive, and a central one perfect; or else, though rarely, the two lateral stamens are perfect, and the central abortive: in every case, however, the filaments, anthers, and the styles of the female organ (the pistil hereafter described), all coalesce into one mass called the *column.* When there is only one perfect anther, it is formed on the upper part of this column; it is two-lobed, and in each lobe is the pollen, cohering in masses of a definite number and shape.

The regular position of the stamens is *alternate* with the petals of the corolla, or with the segments of the single perianth, and therefore *opposite* the sepals of the calyx, when there are two floral envelopes; this is the necessary consequence of their being modified leaves.

In those cases where the stamens are *opposite* the petals, an intermediate whorl of leaves is considered to be undeveloped, or to be *abortive;—Ex:* the order Primulaceæ.

In some flowers, there are twice as many stamens as petals, and then every other one is necessarily *opposite* a petal; in this case, it is frequently found that one or other set is barren, or only partially formed, as in the common brook-weed; or every other filament is shorter, indicating that that set constitutes a different verticil;—*Ex:* erodium and geranium*.

In other plants, one or more of the stamens are constantly absent or abortive; thus, in the order called *Labiatæ*, there are never more than *four* stamens, though the construction of the rest of the flower shows that there ought to be five;—*Ex:* mint, sage, monarda, salvia, &c.

In these, and a great many other plants, which have usually monopetalous irregular corollas, two of the four stamens are always shorter than the others;—*Ex:* broom-rape, vervain, toad-flax, snap-dragon, and the bignonia, maurandya, penstemon, &c. Flowers with stamens of this kind are called *didynamous.*

In cruciferous plants, there are six stamens, two of which are shorter than the rest; these are termed *tetradynamous*, and this structure is only found in this one order;—*Ex.* wall-flower, radish, turnip, &c.

But generally the number of stamens agrees with that of the petals, and is tolerably constant in the same tribes of plants, when this number does not exceed twelve; but if it do, then two flowers off the same plant have seldom the same number of stamens.

The most important particular to be remarked of the stamens of any plant, is the point of the flower or receptacle from which they grow, or, as it is called, their *insertion* or *origin*, since this is found to be generally the same in all those plants which are similar in their structure and properties.

When they arise from beneath the seed vessel, or

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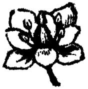
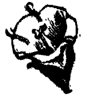
* The learner must be warned that the well-known favourite flower in our parlours and green-houses, is a *pelargonium*, and not a geranium, though commonly so called.



are not attached to the calyx, they are said to be *hypogynous*;—*Ex*: ranunculus, poppy, mallow, grasses, Cruciferæ, &c.



When the stamens appear to grow out of the corolla, calyx, or perianth, or when they are not in any way joined to the seed-vessel, they are said to be *perigynous*;—*Ex*: roses, saxifrage, holly, and Umbellaceæ.

It is generally, though by no means always, found that plants with hypogynous stamens are injurious, or not proper for food, while those with perigynous stamens are innocent, if not wholesome.

But as an instance of an exception, Umbellaceæ, though they have perigynous stamens, are frequently highly poisonous, as for example, the hemlock, fool's-parsley, and the *Œnanthe crocata*; while the real parsley, celery, the roots of carrot and parsnep, and the fruits of the whole order, are innocent.

Flowers with monopetalous corollas commonly have perigynous stamens, or these arise from the corolla; while polypetalous flowers usually have hypogynous stamens.

Few persons could recognise a leaf modified, in the filament and anther of the stamen, but that this is the true origin of that organ, is proved by observation.

In the common white water-lily (Nymphæa alba), the outermost of the floral envelopes is greenish, and approaches the texture of the calyx; a succession of verticils of petaloid leaves form the rest of the flower, the inner ones of which begin to show the rudiments of an anther at their points; these increase and become more and more perfect, while the petals diminish in width, and the innermost have perfect anthers, with flat narrow filaments.

Thus, in this plant, there appears a regular gradation from the herbaceous texture of a calyx or leaf, to a perfect stamen.

Cultivation in a richer soil converts the stamens of many plants into petals, the flowers become what is termed *double*, and, from the disappearance of the anther, cease to be fertile, or they produce no seeds.

The common garden roses, stocks, ranunculuses, poppies, anemones, hollyhocks, and many others, are double flowers produced by cultivation from plants having, in their wild or natural state, many stamens.

These, and many other analogous facts, prove the common origin of the sepal, petal and stamen: that all these are only modified leaves, is further shown by the fact, that it is not uncommon for a plant to produce real leaves in the place of its petals and stamens; and many other circumstances indicate, that it is by changing leaves, that Nature produces all the different organs.

These modifications of one common original organ into so many others greatly differing, are effected by the *vitality* of the plant; and that is all that can be known on the subject.

THE PISTIL.

THE innermost leaf or whorls of leaves of the flower-bud, form the *pistil*, which is called the female organ of the plant, because it encloses the seeds.

Each modified leaf which forms a pistil, is called a *carpellum*, and has its under-side turned outwards, and its upper inwards, or towards the centre of the flower; as most other leaves have theirs turned towards the axis which bears them.

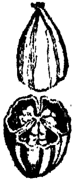
The carpella are folded so that the margins of the leaf are next to the axis, or centre; and from these a species of bud is produced, which is the seed.

The form of the pistil necessarily depends on that of the carpella, on their number, and on their arrangement round the axis, or centre. Each pistil usually consists of three parts, the lowermost called the *ovarium*, or *seed-vessel*, because it contains the seeds—this is formed by the lamina of the carpella; the *style*, which is a continuation of the midrib; and the *stigma*, which is a peculiar termination of this.

The fluid contained in the pollen, when the anther bursts, penetrates the stigma, and is conveyed to the seeds, which are by this means rendered fertile, or endued with the power of growing, and producing a perfect plant like the parent one.

When the carpella have stalks, the ovarium is raised on them; this is seen in the passion-flower, and several others.

The union of the carpella generally forms a hollow case, which is divided into separate *cells* by their margins; when the ovarium is in its complete form, these margins unite in the centre, or axis, and constitute what is called the *placenta*, to which the seeds are attached: the partitions which divide the cells are called *dissepiments*.



In many plants the dissepiments do not reach to the axis, or centre; in this case the ovarium has only one cell, and the seeds are attached to the placentæ, formed by the edges of the carpella projecting inwards; the placentæ are then called *parietal*.

In some plants, the dissepiments are not formed, or subsequently disappear, and leave the placenta in the centre of the ovarium, like a column, with the seeds adhering to it.

These niceties of construction are very important in Botany. They are easiest seen when the seed-vessel is nearly ripe, or in the fruit, as will be presently explained; in the earlier state of the flower it is more difficult to distinguish these various parts.

When the midribs of the carpella unite, they form a single style, and when all the carpella are equal, this arises from the top of the ovarium;—*Ex:* lily, borage, convolvulus, geranium, &c.

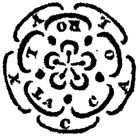
It often happens that though there is only one style, yet there are two or more stigmas; as in the geranium, nettle-leaved bell-flower, grasses, and iris. But when the midribs do not join, then the flower has several styles, as in the nigella, ranunculus, rose, &c.

When there is no style, the stigma is sessile on the ovarium, as in the poppy, water-lily, &c.

The stigma in the Orchis tribe is a viscid space in front of the *column*, which consist of the stamens and style united into one mass. In the violet the stigma is concealed within a cup-shaped termination of the style.

From the laws of the developement of leaves so often mentioned, the carpella of the pistil are properly *alternate* with the stamens, or *opposite* the petals; but these innermost leaves of the bud being crowded, it perpetually happens that some of them are abortive, and this gives rise to an endless variety of combinations of form, which it is impossible to notice in an elementary work like this, and must be learnt from nature.

The annexed figure represents the normal arrangement of the different parts of the flower, supposing this to be regular and perfect.



When the corolla is irregular, it commonly happens that the pistil is also irregular; thus, in Labiatæ, the ovarium consists of four carpella, so formed as to resemble four seeds placed in a square, with a single style, carrying two stigmas, rising from the middle of them, and in other flowers very irregular forms will be found.

There are frequently several whorls of carpella; in this case, they are usually distinct from each other, and do not form a single ovarium with one or several cells; but each carpellum forms a separate pistil with its style and stigma;—*Ex:* ranunculus, sagittaria, water-plantain, rose, &c.

When the receptacle on which these separate pistils are placed is *convex*, or projects upwards, the outer whorl of pistils will be lowest; as in ranunculus, strawberry, &c.

But when the receptacle is *concave*, or *hollow*, the outer whorl will be highest, as in the rose; and in other flowers where several pistils are enclosed within the tube of the calyx.

The position of the pistil with respect to the calyx, is, like the *insertions* of the stamens, an important circumstance to be attended to.

When the ovarium adheres to the calyx so as to grow together, the former is said to be *inferior*, and the latter superior;—*Ex:* currant, gooseberry, bell-flower, Umbellaceæ, and Compositæ.

A singular and obvious example of an *inferior* ovarium is presented by the evening primrose and the common willow-herbs; the long tubular calyx and ovarium, with the flower at its extremity, is easily distinguishable from the flower-stalk. In the œnotheras the segments of the calyx are partly united, so as to present an appearance like an irregular bractea.

When the ovarium does not adhere, but is free from the calyx, it is said to be *superior*, and the latter inferior;—*Ex:* Labiatæ, Leguminaceæ, convolvulus, heath, lily, tulip, poppy, &c.

Besides those already described, there are in many flowers other parts which are either appendages to the former, or abortive whorls of leaves; of these, the principal are—

The *crown*, which is an appendage of the corolla or perianth, and appears like a ring in the narcissus, at the mouth of the tube.

There is found a small scale or appendage of some kind at the base of the petals of many plants, as the Ranunculus for example; they are presumed to be undeveloped stamens.

The *disk* is an undeveloped verticil of leaves, between the stamens and ovarium; in the pæony, it is an elevated ring; in the rose, it is a glandular lining to the tube of the calyx; in the marsh parnassia, it consists of five rounded fleshy scales, fringed with small glands, which are opposite the petals.

These, and the spurs of flowers, the fringes of the petals of others, and many other accessory parts, are called *nectaries*, by some botanists; from their occasionally secreting a kind of honey which attracts bees and other insects. But they are of subordinate importance in vegetable physiology.

The single flowers of many plants produce the stamens without the pistil, or the pistil without the stamens; these flowers are called *unisexual:* they are supposed to result from the one or other set of these modified leaves remaining undeveloped.

And there are a few plants which produce some of their flowers without either stamens or pistil; these are called *neuter*. The outer flowers of the cyme of the common guelder-rose are neuter, as are also many of those of the Umbellaceæ and Asteraceæ, &c.

THE FRUIT.

After the anthers have shed their pollen, they together with the corolla, wither and die off; the pistil, with its enclosed seeds, continues to grow and ripen, and becomes the *fruit*. This is composed of the *pistil*, together with the calyx or other floral envelopes, when these are not deciduous, but continue to grow with the ovarium; as in the hound's-tongue, marvel of Peru, henbane, rose, apple, Asteraceæ, &c.

It must be particularly remembered, that the term *fruit*, in Botany, means the ripened *pistil*, with these accessory parts; because, from the common meaning of the word, beginners are inevitably misled in this branch of the subject.

Many changes take place in the ovarium, as it ripens into the fruit, so that the structure of the two is seldom alike.

Thus from a pistil with an ovarium of several cells, formed by the union of several *carpella*, is sometimes produced a *fruit* with only one cell; this is the case with the cocoa-nut, hazel, primrose, lychnis, beech, oak, &c.

Sometimes, on the contrary, from the division of the placentæ, a pistil with one or two cells only, changes to a fruit with several; thus in the common thorn-apple (Datura stramonium), if the fruit be cut across, that is found to have four cells, though the ovarium is only two-celled; in this fruit the placentæ are very apparent.

The ovarium, when ripened into fruit, is called the *pericarp*; this consists of three parts, which are easily separable in some fruits, as the peach and plum.

The outer skin is called the *epicarp*: the fleshy substance is the *sarcocarp*; and the stone, or shell, is the *endocarp*; the kernel being the *seed*.

But in many fruits the three parts are not distinguishable from each other; as in the nut, where they form only one stony covering, which is the fruit or pericarp: while the part eaten is the seed.

Fruits which open when ripe, so as to enable the seed to escape, that they may reach the earth in order to grow, are said to be *dehiscent;* those which do not open, but fall off the plant and lie on, or in, the ground, till they decay, and by that means suffer the seed to escape, are *indehiscent.*

The pieces into which the dehiscing fruit divides are called *valves.* Fruits generally open by the division of the *dissepiments,* so that the carpella separate: as the fruit of the rhododendron; this dehiscence is termed *septicidal.*

Some open by the dividing of each carpellum at its midrib, so that the dissepiments stick together, and to two halves of contiguous carpella, as the fruit of the martagon lily; this is termed *loculicidal* dehiscence.

Others open by dividing across, as if they were cut by a knife; this is the case with the pimpernel, &c.

Others open by the dissepiments parting from the external part of the carpella, and remaining joined to the central column, as the convolvulus. In the pea and other fruits formed of only one carpellum, dehiscence takes place by the *seam,* or joining, and is thence called *sutural.*

Others do not separate, but small apertures only open to allow the seeds to escape; as in the nigella, snapdragon, poppy, &c.

Fruits* are classed in four divisions, founded on the structure of the pistils from which they proceed.

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* The following arrangement of fruits is partly abridged from Professor Lindley's *Introduction to Botany.*

1. *Simple fruits*—those produced from the pistils of a single flower; and formed from one or more *separate pistils* placed in *one row*, or *verticil*.

2. *Aggregate fruits*—also produced from the *separate*, or *distinct pistils* of a single flower, but arranged in *different rows*, or *verticils*.

3. *Compound fruits*—also proceeding from a single flower, but the *carpella united* so as to form one body.

4. *Collective fruits*—formed from one or more flowers adhering together, and to their floral envelopes, which in an extraordinary state of developement form the principal part of the fruit.

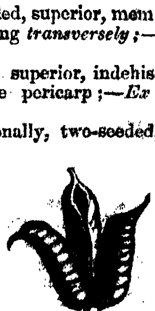
It must be further recollected, that an ovarium is called *superior* or *inferior*, according as it is *distinct from*, or *adheres to* the calyx; and the same terms will be applied to the fruit, which is termed *superior*, when the calyx does not form a part of it, or at least only a separate appendage; and *inferior*, when the fruit is composed of the pistil and calyx inseparably united.

Class I.—SIMPLE FRUITS.

1. *Utricle*—a one-celled, one or few-seeded, superior, membranous fruit; in some instances, dehiscing *transversely*;—*Ex:* oraches, amaranthus, &c.

2. *Achenium*—a one-celled, one-seeded, superior, indehiscent fruit; the seed being loose in the pericarp;—*Ex:* borage, gromwell, and alkanet, &c.

3. *Drupe*—a one-celled, one, or occasionally, two-seeded, superior, indehiscent, fleshy fruit; the *epicarp* and *sarcocarp* separable from each other, and from the *endocarp*, which is stony: *Ex:* peach, plum, apricot, &c.



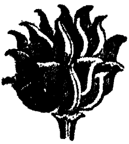
4. *Follicle*—a one-celled, one, or many seeded, superior, dehiscent fruit. The single follicle is formed from one carpellary leaf; but there are but few plants which have a single follicle for their fruit; those composed of several, are very common;—*Ex:* downy-leaved avicennia, paeony, monk's-hood, wolf's-bane, &c.

5. *Legume*—one-celled, one, or many-seeded, two-valved and superior, formed of a single carpellum, dehiscing by both

sutures, or by the margins and midrib; *Ex:* bean, pea, vetch, lupin, and all the natural order of Leguminaceæ.

The legumes of the bird's foot, cassia, cathartocarpus, and, some others, dehisce irregularly, by dividing across into pieces; *false dissepiments* being formed within them, which divide them into several cells.

CLASS II.—AGGREGATE FRUITS.



6. *Etærio*—is of several kinds, and is best explained by examples. In the ranunculus, water-plantain, &c., several dry, indehiscent achenia are placed on a dry *receptacle;* the calyx deciduous.

In the strawberry, many achenia are placed promiscuously on the surface of a *fleshy* receptacle, viz., the sweet juicy part which is eaten; while the yellow shining spots on it, are the real *fruit* of this plant; the calyx persistent.

In the black-berry, dew-berry, cloud-berry, rasp-berry, &c., many fleshy juicy ovaria are crowded, but without coalescing, on a dry receptacle, and are accompanied by a persistent calyx. The separate ovaria in this last example, are considered as achenia *physiologically*, though they differ so greatly in appearance from the regular fruit of that name.

7. *Cynarrhodum*—several distinct, hard, indehiscent pericarps, enclosed within the fleshy tube of a calyx;—*Ex:* rose, hip, &c.

CLASS III.—COMPOUND FRUITS.

8. *Caryopsis*—one-celled, one-seeded, superior, dry, and indehiscent; the pericarp inseparably united with the seed, and known to result from more than one carpellum, by its having the remains of two or more styles; the dissepiments being obliterated, and all the ovules, but one, being abortive;—*Ex:* wheat, maize, rice, and all grasses.

Corn is not a *seed*, as is commonly supposed, but a *fruit;* the *bran* is the membranous pericarp separated by grinding, and the *flour* proceeds from the seed; each grain of rice, also, is a *fruit* enclosing a seed.

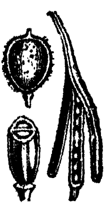
9. *Regma*—three or more celled, few-seeded, superior, dry, and dehiscing, by the cells separating from the axis with elasticity;—*Ex:* Euphorbia, or spurges.

10. *Carcerule*—many-celled, few-seeded, dry and indehiscent, united round a common axis by the styles;—*Ex:* lime-tree, tropæolum, mallow, gerania, &c.

The *carcerules* of the mallow are well known to children, by the name of *cheeses.*

11. *Samar*—two or more celled, few-seeded, superior, dry and indehiscent, distinguished from the carcerule, by having membranous wings;—*Ex:* ash, maple, and elm, &c.; the fruits of these trees are popularly called *keys.*

12. *Pyxid*—one-celled, many-seeded, half superior, dry, dehiscing transversely. This fruit is one-celled, by the obliteration of the dissepiments of several carpella; this is shown by dissection, and by the structure of the ovarium of the flowers;—*Ex:* anagallis, lecythis, &c.



13. *Siliqua*—one or two-celled, many-seeded, superior, dehiscing by two valves, separating from a *false* dissepiment, called a *replum.*

The siliqua is very long and thin, or *linear* in form; but when it is broad and short, it is called a *silicula*;—*Ex:* wall-flower and all Cruciferæ, to which order it is peculiar.

The white oval *replum* of the honesty (lunaria), is well known in winter nosegays.

14. *Ceratium*—this differs from the last, only in its replum being a *true dissepiment*; and is consequently regular in its structure, while the siliqua is irregular;—*Ex:* horned poppy, and bulbous fumitory (corydalis), escholtzia, &c.

15. *Capsule*—one or many-celled, many-seeded, superior, dry, and dehiscent.

This fruit is of more varied forms and texture than any other; the best examples of it are, those of the white or garden poppy, and the devil-in-a-bush (Nigella romana); this last is perfectly regular, and is composed of six carpella, with each a distinct style, and dehiscing by the opening of the sutures at the vertex, the valves not separating: the beginner will learn more by examining the fruit of this well-known garden-flower than by any written instructions.

The capsule of the rhododendron has a septicidal dehiscence; the axis remaining in the centre, and is accompanied with a persistent calyx.

The snap-dragon, Jacob's-ladder, evening primrose, convolvulus, foxglove, horse-chestnut, and innumerable other plants, have capsular fruit. The well-known Brazil-nut is a valve of a woody capsule.

16. *Tryma*—one-celled, one-seeded, with a valveless, fleshy sarcocarp, and a hard two-valved indehiscent endocarp;—*Ex:* walnut, the shell of which, like the peach-stone, is a hard endocarp.

17. *Nuculanium*—two or more celled, few or many-seeded, superior, indehiscent and fleshy, of uniform texture (see berry);—*Ex:* grape and sapodilla plum, or marmalade tree (Achras mammosa); so called from its ripe luscious fruit, resembling quince-marmalade in taste.

18. *Hesperidium*—many-celled, few-seeded, superior and indehiscent, with a spongy separable epicarp and sarcocarp, the cells filled with a pulp, in which the seeds are enclosed; —*Ex:* orange, lemon, lime, &c.

The peel of these fruits is the epicarp and sarcocarp; and the part eaten is separable into *valves*, which are the cells filled with a pulp; the axis, or core, from which the seeds, or pips, have detached themselves, is the placenta.

This fruit has an analogy on one hand with the drupe, and on the other with the capsule.

19. *Glans*—one-celled, one or few-seeded, inferior, indehiscent, hard and dry; the ovarium from which it proceeds contains several cells and seeds; all these are abortive but one or two; it is accompanied with a persistent involucrum, called a cupule; the teeth of the superior calyx, though very small, may be seen on the apex of the fruit;—*Ex:* acorn, chestnut, filbert, hazel-nut.

The learner will do well to compare the structure of the sweet chestnut, (the fruit of the Castanea vesca,) and the horse-chestnut (the fruit of the Æsculus hippocastanum). In outward appearance the two are very similar, each presenting to the eye a green, fleshy, prickly coat. On opening that of the former, it will be found to contain two, three, four, or five separate *fruits* squeezed out of their natural shape, each elongated into a narrow neck, at the end of which may be discovered the five withered teeth of a *persistent calyx*, and within these will be found the remains of twelve abortive stamens. Hence the exterior spiny coat is an *involucrum*, enclosing three to five flowers, each having an *inferior* ovarium, originally composed of six carpella, as is proved by the remains of six styles, and each cell having two seeds; but all of these remain abortive except one, two, or sometimes three, which grow and ripen. The polished brown coriaceous *nut* brought to our tables is the *fruit*, which we do not eat, but peel off to get at the seed or seeds, for there are sometimes two, or even three, which are covered with a thin brown skin, or *testa*, as will be hereafter explained.

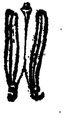
If we open the spinous coat of the horse-chestnut, we find it to consist of three valves, or cells, in one, two, or all of which is a beautiful brown *seed*, and if we examine the cells carefully, we find in each a small unmatured seed, squeezed by its larger neighbour into a recess in the dissepiment; sometimes one seed of each cell grows equally, but usually only two ripen in the whole fruit. Hence it appears by this structure, that in this case the exterior spiny coat is a *true superior fruit*, formed of three carpella, each cell containing two seeds, only one of which ever grows to maturity, and commonly only one of two of the cells, the two seeds of the third being prevented from growing by the developement of the other. The polished brown coat of these seeds is the *true testa of a seed*, and not the *true epicarp of a fruit*, as the similar looking part of the sweet chestnut has been shown to be.

The *fruit* of a horse chestnut is a fleshy *capsule*.

The *fruit* of the sweet chestnut is a coriaceous *glans*, two or more of which are enclosed in a fleshy involucrum.

20. *Cypsele*—one-celled, one-seeded, indehiscent, the seed loose in the pericarp; formed from an ovarium of two or more carpella, differing from the achenium only in being inferior;—*Ex:* the whole natural order of *Compositæ*.

It is this fruit which, crowned by the *pappus*, or feathery limb of the calyx, is so well known on the leontodon, groundsel, thistle, &c., &c.; when the fruits are blown away, the cushion-like receptacle is very apparent, with or without the membranous bracteæ.



21. *Cremocarp*—two to five-celled, and one-seeded, dry, indehiscent, and inferior, separating from the axis, the seeds adhering to the pericarp;—*Ex:* the whole natural order of Umbellaceæ, and some other plants, as the goose-grass.

The well-known *fruits* of the Umbellaceæ, coriander, carraway, dill, anise, &c., commonly, though erroneously, called *seeds*, are familiar to every one, and afford a ready means of examining the structure of the cremocarp, which is very peculiar.

22. *Pome*—two or more celled, few-seeded, inferior, indehiscent, and fleshy; the seeds enclosed in cavities, having a tough, parchment-like lining (the core), formed by the cohesion of several pistils, with the tube of the calyx in an extraordinary state of growth, which constitutes the whole of the soft eatable part;—*Ex:* apple, pear, medlar, service, quince, &c.

The *eye* of these fruits consists of the withered segments of the calyx.

23. *Pepo*—one-celled, many-seeded, inferior, indehiscent, and fleshy; the seeds attached to parietal pulpy placentæ; the whole cavity is in many species filled with pulp, in which the seeds are buried;—*Ex:* cucumber, melon, gourd, vegetable marrow, &c.; in this case also, the withered segments of the superior calyx are observable.

24. *Bacca*—many-celled, many-seeded, indehiscent, inferior, and pulpy; the seeds scattered in the pulp, the calyx forming the substance of the fruit, and having its withered segments perceivable at the apex;—*Ex:* gooseberry, currant, &c.

25. *Balausta*—many-celled, many-seeded, inferior, indehiscent, pulpy within, from the outer coat of the seeds, and not from any part of the fruit itself, being so;—*Ex:* pomegranate.

Class IV.—COLLECTIVE FRUITS.

26. *Syconus*—a fleshy hollow *receptacle*, filled with flowers, with their achenia consolidated into one mass;—*Ex:* fig, dorstenia, &c.: the achenia in the dried fig, are very perceivable in the thick clammy substance, which is produced from the flowers, the leathery outside being a receptacle.

27. *Strobilus*—an *amentum*, the pericarps of which, instead of enclosing the seeds, are imbricated woody scales; sometimes opening when ripe, and allowing these to fall out;—*Ex:* pine, fir, larch, and the whole order of *Coniferæ*, which derive this name of *cone-bearing* from the form of their fruit.

28. *Sorosis*—a *spike* or *raceme* converted into a fleshy fruit by the cohesion of the flowers with their pericarps;—*Ex:* pine-apple, mulberry, and bread-fruit.

Of these numerous species of fruit, the learner should thoroughly understand the structure of the drupe, follicle, legume, etærio, capsule, siliqua, and pome, as being the types, as it were, of this important organ of vegetation.

But though it is necessary, for the purpose of arranging them, to give the various forms of fruits names apparently difficult, yet it is by no means necessary that they should be committed to memory, provided the learner distinctly understands in what way the essential parts of the pistil are modified in the transformation of it into the fruit. For this reason his attention is particularly called to the fruits of the ranunculus, strawberry, rose, apple, raspberry, sweet and horse-chestnut, fig, mulberry, and pine-apple.

THE SEED.

The small bodies produced on the margins of the carpella in the pistil, are called *ovules* (or little eggs); when they are matured, they become the *seeds*, and are the final object for the perfection of which the complicated and beautiful structure of the reproductive organs was contrived.

The *ovules* are generally attached to the placenta of the ovarium by a little stalk; they consist of two cases, one enclosed in the other,—the innermost contains the *embryo.*

The mouths of these cases are usually nearly closed; the small opening left is called the *foramen,* and through this the fluid contained in the pollen passes to the embryo, and endues it with vitality; and it is known, that if, by any means, this impregnation is prevented, the seed will not grow or produce a plant.

The *seed,* or ripened ovulum, consists of coverings called *integuments,* or seed-coats, the outer of which is named the *testa.* These coverings are separable in some seeds, as the walnut, the seed of the water-lily, and others; but more commonly they adhere too closely to be separated, though from the colour and texture of the two sides of the integuments, they obviously consist of two or more coats.

The *testa* is of very different colours in different plants; it is black and polished in the fumaria; red and glossy in the Angola-pea; brown in the nut; rough and wrinkled in the date, nutmeg, &c.; beautifully spotted in the common scarlet-bean; and, in short, of endless shades of colours and markings.

In the pomegranate, the testa is pulpy, like a berry (see *Balausta,* in fruits).

Cotton is a hairy covering of the seeds, and fills the capsular fruit, of a plant called *gossypium.* In some seeds, the stalk swells out into a fleshy covering, called the *arillus;* but this is only an appendage to the seed, and found but on a few.

Mace is the arillus of the nutmeg, which is the seed of a fleshy drupe, the fruit of the *Myristica moschata.* The arillus of the passion-flower is pulpy, and gives the seed the appearance of a berry.

The red arillus of the seed of the common spindle-tree (Euonymus europæus) is well known, and is very ornamental in our hedges in the latter part of Autumn; this arillus becomes visible from the dehiscence of the fruit.

The foramen is often visible on the seed, and is then named *micropyle;* it is seen in the pea and bean.

The scar on most seeds indicates the point at which the little stalk joined, and is called the *hilum.* It is very large and obvious on the horse-chestnut.

A swelling, often coloured, is seen on many seeds; this is the *chalaza;—Ex.* lemon, orange, &c.

These three characters are important, as will be presently shown.

Within the integuments is found the *embryo;* in many plants this fills up the whole space, as in the pea, bean, rose, &c.

But when it does not, a substance called *albumen,* or *perisperm,* occupies the remainder; the presence or absence of this is found by botanists to be an important character in plants.

The greater part of the seeds of grasses, such as wheat, barley, rice, maize, &c., is composed of albumen, and is what is termed *farinaceous* in quality.

The embryo, which is the future plant in a rudimentary state, and is therefore the important part for the nutrition and protection of which all the rest are contrived, consists of,

The *plumule,* which grows into the stem and axis of the future plant (see p. 88); this is very distinct in the bean, horse-chestnut, and some others, but in most plants it can hardly be discovered without a magnifying glass, or by dissection, and in a great many it appears only when the seed begins to grow or *germinate.*

The *radicle,* which is the origin of the root of the future plant (see p. 88), like the plumule, is visible or not in different plants; it is always turned towards the *micropyle,* or foramen, when the seed is ripe.

At the point of union in the radicle and plumule is found the *seminal leaf* or *leaves*, called *Cotyledons*, or seed-lobes; they are always next the *chalaza;* these form the mass of the seed in the bean, and all those which have little or no albumen.

In some plants they come up above-ground as the seed sprouts, or germinates, as the bean, lupin, convolvulus, marvel of Peru, &c.; in others, as the horse-chestnut, and all grasses, they do not appear, but remain in the earth enclosed in the integuments.

The most essential difference in the structure, mode of growth, the character of the plants growing from the seeds, is found to be connected with the number, or position, of these small organs, the cotyledons.

Those plants, the seeds of which have either only one cotyledon, or if more, these *alternate* on the embryo, are called *monocotyledonous;—Ex:* grasses, duck-weed, lilies, orchises, aloes, bananas, iris, and all palms, &c., &c.

Plants of this class are easily recognised by the veins of their leaves being parallel, or not *reticulated* (see Leaves).

Those plants, the seeds of which have two or more cotyledons, and these *opposite*, or verticillate, are called dicotyledonous;—*Ex*: timber-trees, cabbage, parsley, lilac, rose, pea, water-lily, &c. &c.

Plants of this class are recognised by the *reticulation* of their leaves (see Leaves), and other characters which will be hereafter explained.

Plate I. represents the characteristics of dicotyledonous vegetation; the tree on the left hand is the mangrove (*Rhizophora mangle*), a native of tropical countries, growing on the sea-shore, its singular roots forming a thick interwoven net-work above the water; it is also remarkable for its seeds germinating while in the fruit, yet hanging on the tree; they

PLATE I.

PLANTS PRODUCED FROM SEEDS HAVING TWO, OR VERTICILLATE, SEED-LEAVES.—(*Dicotyledons*)

send down a radicle of some inches in length, which, when the embryo drops, sticks in the mud, and continues to grow.

On the right-hand side are three species of Cactus, a very singular tribe of plants, remarkable for their leafless prickly stems, and beautiful flowers. The prickly pear, and the Indian fig, are two species of these plants, many of them form impenetrable fences; and one, the melon-cactus, affords in the most arid plains of tropical countries, a cool and refreshing drink to many animals.

In the middle of the plate, and also near the Cacti, are two species of Euphorbias, or spurges, some of which resemble Cacti in appearance; and on the edge of the water, between them, is the cotton-plant (*Gossypium herbaceum*), to which civilized man is indebted for great part of his clothing.

The lofty forest-tree in the back-ground is the mahogany-tree (*Swietenia mahogani*), one of the largest and finest timber-trees in the world; to the left of it is seen the Casuarina, a native of New Holland, a leafless tree of singular form and structure: in the water are shown the white water-lily (*Nymphæa alba*), the common mare's-tail (*Hippuris vulgaris*), with its verticillate leaves; and the *Nelumbium speciosum*, an aquatic, with beautiful and fragrant flowers, and handsome *peltate* leaves, affording in its roots, stalks and seeds, a pleasant wholesome food to the Chinese and Japanese.

In Plate II., on the other hand, are represented a few of the types or principal forms of monocotyledonous vegetation; the right-hand tree is the cocoa-nut, one of a very numerous tribe, the palms, which are considered by botanists as peculiarly representing the class; on the left-hand side is the singular palm called chamærops, the only one of the order which ever grows wild in Europe; the whole tribe being confined to tropical countries, where they form the most majestic trees, from their height and their beautiful foliage.

In the centre of the plate is the banana (*Musa paradisiaca*), a plant which furnishes food to the greater part of mankind in the tropics, as the grasses do in the temperate and northern regions; in the distance is seen the aloe, a large tribe of plants, some of which are remarkable for flowering at very distant periods, when cultivated in colder climates; and in the left-hand corner may be distinguished two species of the orchis tribe, before noticed for its singular flowers.

On the right-hand, under the cocoa, are some representatives of the grasses, to us, inhabitants of the north, the most important tribe of all plants affording food for man; in the foreground are seen, in succession, from the orchis, a *Yucca aloifolia*, or aloe-leaved Yucca; *Tillandsia anceps*, of the pine-apple tribe; an iris, a lachenalia; and beyond the banana is the fan-palm.

OF THE ELEMENTARY ORGANS, AND INTERNAL STRUCTURE OF PLANTS.

All the various parts which have been described appear to be produced from the combination, in different states, of two elementary organs, *Membrane* and *Fibre*.

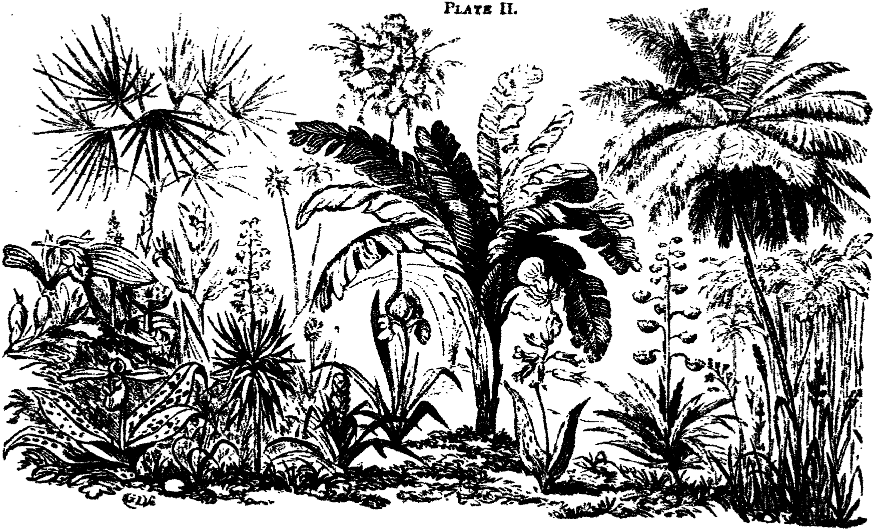
Membrane is occasionally so fine and transparent, that its existence is only detected by its optical effects on light transmitted through it, or by the adhesion to it of minute bodies; but sometimes it is of sufficient substance to be perceptibly coloured. Like all other organised tissue, this vegetable membrane admits of fluids passing through it, but no *pores*, or openings, have been yet detected in it, even with the aid of the most powerful microscopes; when thus examined, it presents a perfectly uniform and homogenous texture.

Fibre resembles hair of such extreme minuteness, that its diameter, often, does not exceed the 1200th of an inch; it is usually transparent and colourless, but is occasionally of a greenish hue. It usually adheres to membrane, and elongates as that grows, or else is ruptured by the process into small fragments, which indicate its former direction; it is commonly twisted spirally among the membrane, and becomes reticulated, or anastomoses.

There are three principal forms in which membrane and fibre are combined.

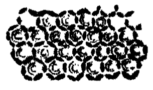
1. *Cellular tissue*, or *parenchyma*, consists of minute

PLATE II.



PLANTS PRODUCED FROM SEEDS HAVING ONLY ONE, OR ALTERNATE SEED-LEAVES.—(*Monocotyledons.*)

bladders, or vesicles, of membrane or fibre alone, or of membrane and fibre together: each bladder being distinct, and separable by maceration in water from the rest, but crowded together so as to resemble in form the hexagonal cells of a honeycomb, or the foam of liquor in a state of fermentation; only that the vesicles of cellular tissue do not, on an average, exceed the 500th of an inch in diameter. It is always colourless, like the membrane composing it, and when the parts of the plant formed of it are coloured, as are the corollas, &c., of flowers, or the herbaceous parts generally, this arises from coloured matter contained in the cells or bladders.



Cellular tissue admits of the passage of water through it, but whether the fluid only penetrates through the interstices left by the globular form of the cells, or whether it passes through the membrane into the cells, is not accurately known; its substance is destroyed by long maceration in water, as will be again subsequently mentioned.

The vesicles of cellular tissue are largest in the pith of plants, and in aquatic plants generally, and in some tribes, such as *Cucurbitaceæ*, where they are sometimes as much as the 30th of an inch in diameter, but the smallest vesicles do not exceed the 1000th of an inch.

The substance contained in the vesicles, which gives the colour to the compound organs of the plants, is frequently entirely fluid, but that which imparts the green to leaves and all herbaceous plants, is in the form of granules floating in a greenish fluid, filling the vesicles. This fluid dries up in time, and the granules turn brown,—a change which is manifested in the withered leaves, &c., of a decaying plant.

Little or nothing is known of the mode in which cellular tissue multiplies itself during the growth of the parts: it is possible that, like the blood of animals, it has a distinct vitality, and that the multiplication of the vesicles composing it is by no means the result of a mere organo-chemical action. However this may be, the rapidity with which cellular tissue increases, by the formation of new vesicles, is astonishing; many plants grow perceptibly to the naked eye, and this must necessitate the formation of many thousand cells per hour. It should, however, be mentioned, that a celebrated living botanist denies the production of new cellules, and attributes the growth of the organs of plants entirely to the enlargement of cells existing in a latent, or undeveloped state, even in the embryo; this, however, is an hypothesis extremely difficult to be reconciled with facts in vegetable history.

Cellular tissue is commonly formed of membrane only; it is this state of it which may be considered as constituting the basis of all plants: many consist of nothing else, as Mosses, Lichens, Fungi, Algæ, &c. and the parenchyma of leaves and all modifications of them, the pith, medullary rays, the bark, and all pulpy parts of fruits, seeds, roots, &c., in all phanerogamous plants are entirely composed of it.

When this tissue is compressed by the form of the part constituted of it, its spheroidal figure becomes modified in various ways, and the cells are square, prismatical, fusiform, &c,; it is only found in its true globular form in the pith, and in the pulpy parts of fruits, &c.; in leaves, stems, bark, medullary rays, &c., it is always of an elongated form

Cellular tissue composed of membrane and fibre twisted spirally round the cells, has been found in the lining of the anthers of most plants which have been examined with this object, also in the leaves of many, and probably its presence is more general than is yet supposed. Cellular tissue consisting of fibre only, has been detected in certain parts of several plants; but this state of tissue has not been sufficiently examined, to render it certain whether it should be considered as a distinct kind of tissue, or only a modification of another form of elementary organ, to be presently described.

2. The second principal form of *elementary membrane* is called *woody fibre;* this consists of excessively minute membranous tubes, tapering to sharp-pointed ends, collected in bundles, and, like cellular tissue, having no *visible* communication with each other.

These tubes are, on an average, much finer than the finest hair; the largest being about the 150th part of an inch in diameter.

Woody fibre is not destroyed by soaking in water, like cellular tissue; and it is to woody fibre that plants owe their strength, or power of supporting themselves; for it forms by far the greater part of the stem and branches, all stalks, roots, and the veins of the leaves, and all parts which are *woody* in texture. All the textile fabrics made from vegetables, such as those from cotton, flax, hemp, &c., owe their strength and tenacity to woody fibre.

Granules, like those formed in cellular tissue, have also been detected in the tubes of woody fibre, and in some cases there are glands visible on the tubes.

3. The third form of *elementary membrane* is termed

vascular tissue, which consists of membranous tubes, tapering to the ends as the last; it is of two forms:—

A.—*Ducts*, which are membranous tubes, having their sides marked with bars or dots, arranged spirally round them, but differing from the next form in not unrolling; they are large enough to be visible to the naked eye, and are plainly seen when a cane, or oak, or vine-branch is cut across.

B.—*Spiral vessels* are membranous tubes with a fibre twisted spirally round the inside, which is capable of unrolling something like a bell-spring, when the membrane is torn; or when the membrane does not exist, the vessel is formed of fibre only; spiral vessels are also called *tracheæ*.

If a young shoot or stalk be broken very gently, and held up to the light, the spiral vessels may be seen by the naked eye; the ordinary size of them is about 1-1000th of an inch, but they occur in some plants as much as 1-250th and in others not 1-3000th of an inch in diameter.

They are found in all parts of the plant which are formed, or grow, upwards, or in an ascending direction, but not in the root, wood, or bark; these, as will be explained, being formed in a downward direction; there are, however, exceptions to this rule.

They have as yet only been found in plants which proceed from seeds produced by the agency of sexual apparatus in a flower, and never in those which do not bear flowers, as mosses, mushrooms, sea-weeds, funguses, and lichens, &c.; in ferns, however, and some other flowerless plants, a modification of spiral vessels is found.

The use of spiral vessels to plants is not accurately known; it is, however, presumed that they serve for the circulation of air through the plant.

When the delicacy and minuteness of the elementary organs are considered, it will not appear surprising that botanists are not quite certain either about their mode of formation or their functions. Every new and more accurate observation brings to light some new curious property respecting them, but their details cannot be entered upon in an elementary work.

Every part of the plant, except the stigma, and the extremities of the fibres of roots, is covered with a skin, called the *cuticle*.

This is formed of cellular tissue pressed flat, and the marks of the cells can be seen on it, if examined by a microscope; it cannot be separated from the plant without tearing, and is, therefore, not so much a distinct part, as the surface of the external tissue in a particular state.

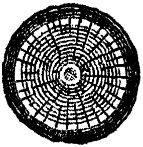
There are pores or openings, called *stomata*, in the cuticle of most plants; they are supposed to be organs of *respiration*.

The cuticle does not readily allow of the passage of moisture, and for this reason the extremities of the roots are destitute of it; it is, consequently, by these that water is absorbed from the earth, and not by the whole body of the root. Hence the necessity of preserving with great care the finest fibres of the roots of plants, in transplanting them.

It may be here remarked that, for the same reason, watering the leaves of plants refreshes them by washing away the dust and dirt which, by clogging up the pores of the cuticle, prevent the necessary respiration; and that a plant could not be kept alive if moisture were not allowed to get to its roots. When a branch or flower is broken off and placed in water, it absorbs moisture chiefly by the extremity, and but little by the rest of the surface immersed in the liquid.

For the analogous reason, the stigma is destitute of cuticle, to afford access to the fluid of the pollen.

OF THE STRUCTURE OF THE STEM.



If the stem of a *dicotyledonous* shrub or tree be cut across, it will be found to consist of the following parts:—

In the centre is the *pith;* this consists of cellular tissue slightly compressed; in herbaceous plants it occupies the greater part of the stem; but in old trees its cells are filled up by the thickened juices of the plant, and it differs little in appearance from the wood; its use, apparently, is to feed the buds and vascular tissue when they first appear in the early stage of growth of the plant, with all of which it is in direct communication; it never alters its diameter, after it is once formed.

In consequence of the vascular system developing faster than the cellular, the pith is much torn and separated in many plants, and in some, is even totally removed, as in the fistulous stems of Umbellaceæ and other tribes, which become hollow from this cause.

The *medullary sheath* surrounds the pith, and consists of a tissue of spiral vessels and ducts; these communicate directly with the stalks and veins of the leaves; the water, taken up by the roots, passes through these tubes, and the tissue of the stem generally, into the leaves, where it undergoes a chemical change from the light and air, and is thus converted into the proper food for the various organs.

The veins of the leaves are ramifications of the medullary sheath.

The *wood* is found next; this, in a plant of more than two years' growth, consists of distinct layers, one being formed each year during the life of the tree; and hence the age of a tree may be known, nearly, by the number of rings of wood in the trunk at its base.

These layers are not separable from each other; they consist of elongated cellular tissue on the side next the centre of the stem, and externally of woody fibre and ducts.

It is these vessels which are seen in the *grain* of mahogany and other wood when cut.

The layers nearest the centre are the hardest, because the vessels of these are filled up, in the progress of time, with the secreted juices of the plant; the layers of wood never increase in diameter after being once formed.

The outward layers are softer, and not completely formed; these are called *alburnum;* one of these layers it is which is produced each year, and which increases the diameter of the stem. It is in the alburnum that the vital action is in its greatest energy, and it is through its vessels that the sap chiefly ascends.

As the tubes of each layer of the alburnum are filled up and hardened in succession, they become wood, and then cease to perform vital functions. Spiral vessels are never found in the wood or alburnum,

The *bark* covers the wood; it constitutes the outer part of the stem; this bark also consists of layers, each composed of woody fibre and ducts inwardly, and extended cellular tissue outwardly, just the reverse of those which compose the wood.

The inner part of the bark is called the *liber;* it gives birth to the new roots, buds, leaves, and everything that proceeds from a bud.

The bass, or Russian mats, so useful to gardeners, are prepared from the liber of a species of lime-tree.

It has been stated that the medullary sheath furnishes the vascular tissue to the buds and leaves, and supplies them with sap to elaborate; this is the case only in the earliest stages of a new shoot or branch; and it is well known that such a shoot may be deprived of its bark and wood, and yet flourish, if the medullary sheath remain uninjured; but that, if this be cut through, no new bud will be developed *above* the wound.

The medullary sheath, however, is not permanent in its site and size like the pith; when the stem or its branch has lived for many years, the medullary sheath is represented by the inner part of the alburnum, which now fulfils its functions, and hence an old tree may grow and flourish for many years after its stem is completely hollowed out of its ripe wood, provided the alburnum and liber remain uninjured.

The outer tissue of the bark is called the *epidermis*; this is the part in timber-trees which is cracked by the growth of the stem, injured by the exposure to the sun and air, and drops off; while the exterior layer of the liber is continually supplying its place.

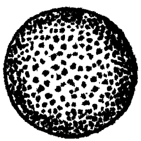
Hence, while the wood increases by a new layer every year, the bark remains of nearly the same thickness; in old trees, therefore, it is thin, compared to the diameter of the stem.

When the stem of a dicotyledonous plant is cut through, faint, interrupted lines are seen radiating from the centre outwards, like the spokes of a wheel; these are produced by the *medullary* rays, which consist of compressed cellular tissue, the cells being lengthened out horizontally, or across the grain of the wood; they connect and bind together the layers of the stem, and allow of the passage of the fluids, prepared by the leaves, into the ducts and vessels of the wood. No vascular tissue is ever found in the medullary rays. It is these which give the glossy silky appearance to certain woods, as the plane, sycamore, and satin wood.

These various parts are not distinguishable in very young stems, nor in herbaceous annual plants; in these last, the layers of wood and medullary rays are, of course, wanting; and the stems are composed of epidermis, liber, and pith, with a medullary sheath of spiral vessels and ducts.

The thick herbaceous fistulous stem of the common cow-parsley is a good subject for examination; and for perennial stems, a young elder-branch may be taken.

The stem of a *monocotyledonous* plant does not present the appearance of distinct parts, when it is cut across; there is no distinction of pith wood and bark, and there are no medullary rays.



It consists of bundles of woody fibre and ducts, dispersed irregularly among a mass of lengthened cellular tissue, and crowded together towards the outside.

It increases by the successive descent of new bundles of fibre into the centre of the cellular mass; these force the former outwards, but when the external coat becomes hardened, the stem can increase no further in thickness.

The plants of this class, in our country, are only annual and herbaceous, and the structure of their stem does not admit of being observed. It is only in the palms, bamboos, &c., of tropical regions, that the mode of formation can be ascertained; consequently this is not so well known to botanists as the structure of the dicotyledonous stems.

OF THE GERMINATION OF THE SEED, AND GRADUAL GROWTH OF THE STEM.

When a seed is sown in a proper soil, where a certain warmth, air, and moisture, can get to it, and where it is excluded from the light, it begins to sprout or *germinate*, oxygen is absorbed from the atmosphere, carbonic acid is given out, and vital action commences in the embryo: the tissue which composes the embryo swells and bursts the seed-coats, the *radicle* appears, and descends deeper into the earth, whatever may have been the position of the seed in the ground.

At first, the radicle receives nourishment from the cotyledons or from the albumen, till it becomes capable of deriving it from the earth itself; the *plumule* next forces its way upwards to the surface, and, in some seeds, carries the cotyledons with it, in which case they become green by the deposition in them of carbon, produced from the action of the light; these cotyledons supply the place of leaves, till those which compose the plumule open out and grow.

In those seeds, the cotyledons of which remain under ground, the plumule is more formed, and opens immediately on its appearance; the two leaves which compose it grow very rapidly, and perform their proper office.

At this early stage the young plant consists of cellular, with an imperfect vascular and fibrous tissue in the form of a cylinder, just perceptible in the centre; the inner part of this cylinder is destined to become the future pith; the external coat will become liber, and the cylinder itself is the future medullary sheath, and consists of vertical fibres passing through, and interlacing with, cellular tissue.

The radicle next absorbs nourishment from the soil; this passing upwards to the plumule, through the cellular tissue of the pith, becomes modified by the light and air when exposed to their influence in the cotyledons, and then returns to the root through the liber.

As soon as the plumule has elongated upwards, it begins to send down fibres into the centre of the radicle; and these fibres constitute the first rudimentary *wood*. But during this process the plumule develops and matures one leaf, or two, according as the species has alternate or opposite leaves. These leaves now fulfil their proper functions in a more complete manner than the cotyledons which had previously performed them; and the leaves give rise to more perfect descending fibres, which form a cylinder of alburnum between the medullary sheath and the bark. As the shoot grows upwards, new buds develop into leaves around it, in the axillæ of each of which a bud is formed, destined in the ensuing season to develop in their turn into lateral branches.

At the end of the first season the original seed has produced a shoot with a woody axis, with distinct pith and bark; and when its first leaves wither and fall off from the cold of Autumn, a minute bud is left at the site of each, arranged symmetrically round the stem. The shoot is of a conical or taper form, because its lower part comprises the fibres of all the buds above; therefore, the higher up the stem, the fewer buds there are above to contribute to the diameter at that part; while at its extremity there is no wood, the shoot ending in a bud, which will increase the length of the stem, when the returning Spring causes the buds to develop.

When this cause excites into activity the vitality of the buds which had been torpid during the Winter, they suck up the remaining sap from the tissue in their neighbourhood, and thereby cause an action throughout the stem to supply the deficiency; this action is the ascent of the sap. Each bud, thus nourished, elongates into a new shoot or axis, by the repetition of the process which produced the original shoot from the seed, only that the office of the cotyledons is answered in the new shoots by the store of sap deposited in the stem already formed.

Each bud also sends down its roots or fibres between the bark and the wood formed in the preceding year, in order to form a new layer of both. A glutinous, slimy, mucilaginous juice, called cambium, exudes from each of the previous layers, to facilitate the transmission of these fibres, to furnish them with nourishment till they reach the soil, and also, probably, to supply new cellular tissue to elongate the medullary rays, or that portion of tissue which from the first had been intermingled with the rudimentary vascular cylinder before mentioned.

In what way this process is successively repeated during the growth of perennial plants, is not exactly known. It appears most probable, that the new layers of alburnum and liber, which are produced each year on the outside of all that preceded, are formed by the descending fibres, or roots, of the leaf-buds; which fibres are nourished by the cambium: the medullary plates are also extended horizontally, by additions made to them from the cambium, so as to preserve the communication between the liber and the centre of the stem.

The same process goes on in the branches which originally sprang from the buds. The trunk of a tree is, therefore, a series of cones of wood covering one another, the innermost being that produced the first year, and the outermost extending from the extremity of the last shoot down to the base.

For some period after its origin depending on, or related to, the duration of the plant, its whole energy is expended in increasing and expanding itself, or in forming new organs of nutrition, or, rather, in multiplying those already existing; but after the lapse of that period, the final aim of all organic beings, the reproduction of the species, gives rise to some unknown modifications in the vital actions, and buds of a particular form are produced, which, instead of developing into new axes with leaves placed at different distances on them, develop into *flowers*, the leaves being modified in form, texture, and office, and expanding in verticils round the axis, which no longer elongates, when the petals, stamens, &c., are once formed in the bud.

In herbaceous plants that only live a year, the stem is formed as before described; but no cambium is produced, and no buds in the axillæ of the leaves, the energy of the plant being exhausted in flowering and perfecting the seeds.

The plumule of the embryo of most *monocotyledonous* plants differs entirely from that with two cotyledons; it is composed of leaves, which wrap round each other; these open when germination has brought the plumule to the surface of the ground, and new leaves are formed in their axillæ, which force the first outwards; these now die off, and leave a ring composed of their bases, hardened by growth into a kind of wood; the second set, in their turn, leave another ring on the former, and so on; in this way, the thin but lofty stipes of palm-trees are formed, a bud of leaves being produced each year at their summits, and the rest of the stem being composed of the bases of the leaves of previous buds.

In large tree-like monocotyledonous plants, generally only one leaf-bud is developed at the top of the stem; and hence, from what has just been said, arises the cylindrical unbranched stem of palms.

In those plants of this class which develop two terminal buds, the stem becomes *dichotomous*, and these branches are cylindrical, like the stipe; but when leaf-buds are developed in the axillæ of all the leaves, as is the case with the dragon-tree, asparagus, &c., and in tree-like grasses, then the conical-branched form of stem is found in monocotyledonous, as well as in dicotyledonous plants; but the subject of the growth of these kinds of stems, like many other parts of the science, is not yet sufficiently understood.

OF THE FOOD AND SECRETIONS OF PLANTS.

THE roots of plants suck up water from the earth, containing small quantities of various mineral substances; of these, such as are hurtful, or not necessary, are separated by the vitality of the root. The water, nearly pure, but having mucilage, apparently acquired in the plant, dissolved in it, is in this state called *sap;* it ascends by the vessels of the stem, but principally by those of the alburnum. The causes of its ascent in the stem are not known with certainty.

The sap passes through the stalks into the leaves, where it undergoes peculiar chemical changes, which could not be explained here. A great part of the pure aqueous part is carried off, or evaporates, and the rest returns along the lower set of vessels of the leaf back into the stem, passing down the liber, and horizontally to the centre, by the medullary rays, towards the roots, in order to supply food, or nutriment, to the various organs. In this state it is called *proper juice.*

It is supposed that the cambium is chiefly formed of this prepared and descending sap.

But, in addition to this, the leaves, and all the *green* part of plants, absorb from the atmosphere a peculiar air called *oxygen;* this unites with the different substances contained in the sap, and forms, by that means, the various oils, gums, resins, and other vegetable productions of plants and trees.

It is also known as a *fact*, though the reason is hid from us, that the oxygen is required to be united to another vegetable substance abounding in plants, called *carbon;* they thus form a peculiar air, called *carbonic acid gas* or *fixed air*, which is very injurious to animal life, and which is breathed out, as it were, by the plant during the night; it is this which makes it unwholesome to sleep in a room with plants.

On the contrary, when the sun shines on the leaves and herbaceous parts, this *carbonic acid* is again separated into its component elements, the pure air, or *oxygen*, is given out again by the plant, and the *carbon* forms the new woody fibre.

Hence, when a plant is kept in the dark, it has not the power of forming woody fibre; the stem becomes weak, soft, and long, loses its colour, and in time dies, from its unnatural mode of growth. It is on this property that the process of *blanching* is founded; by excluding the solar light from the leaves of plants, the sap is prevented from being converted into proper-juices, which are strong, and often poisonous; hence, for example, wild celery is deleterious, and the cultivated is innocent by being blanched, in consequence of the stem, &c., being earthed-up during its growth.

On the contrary, when a plant is kept in too strong a light, or is exposed too much to the sun, the solid matter is formed so fast as to check the growth, by not allowing the various parts to expand themselves properly; the plant becomes stunted, the leaves are small, and the stem thorny, or hairy; this is the case with those plants which grow on heaths, commons, or high hills.

OF FLOWERLESS PLANTS.

THERE is a very large class of plants which essentially differ from those described in the former part of this work.

They are, as yet, but imperfectly understood; the principal fact known about them is, that they are produced from, or propagated by, minute bodies, differing from *seeds*, in germinating from every part of their surface, and not from two points only, as the radicle and plumule of an *embryo:* hence *most* of these plants have not, physiologically speaking, a distinct root and stem. Another characteristic is, that they do not bear *flowers* with stamens and pistil, distinguishable from each other; and it has been found that, generally, their substance consists principally of *cellular tissue* only, without spiral vessels.

The herbaceous parts of flowerless plants resembling leaves, are called *fronds;* they differ, in several particulars, from true leaves in their structure.

The forms of the different tribes of *flowerless plants* are even more varied than those of *perfect plants;* and the small bodies from which they are reproduced, are not less so: the innumerable species are principally classed under the following orders:—

1. **Ferns** more nearly approach flowering plants in structure than the rest; they have a kind of stem, consisting of woody fibre, and containing false spiral vessels; this stem is formed of the bases of their *fronds*, which are of very different forms: many ferns are large plants, even in this country; and abroad, in hot climates, they are frequently thirty feet high.

They are propagated by minute bodies, called *sporules*, enclosed in cases called *thecæ;* these are produced, either on the backs, or in the axillæ of the fronds, and on other parts, usually in a kind of blister under the cuticle, called a *sorus*;—*Ex:* horse-tail, brake, ferns, &c.; the sori are very obvious on the back of the beautiful *fronds* of these plants in Summer and Autumn; the fern is found on heaths, commons, in woods, or in sheltered and retired places everywhere.

2. **Mosses** are small plants, having an imperfect stem, and very small, irregular fronds. They grow in woods, under trees, on bogs, rocks, and, indeed, almost everywhere; but are more abundant in temperate and cold climates. They are among the earliest plants which appear to clothe the barren rock. All the plants *commonly called moss*, and of which birds make their nests, do not belong to this tribe.

Their organs of reproduction consist of sporules, contained within an *urn*, or *theca*, placed at the top of a thin stalk; this is closed with a lid, called an *operculum*, and that, again, is covered with a hood, termed a *calyptra;* but these organs vary greatly;—*Ex:* Sphagnum, Hypnum, Marchantia, Jungermannia, &c. There are 800 different species of mosses alone.

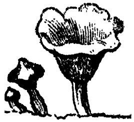
Neither vessels nor woody fibre enter into the composition of this order, nor of any of the others that follow it, their substance being entirely composed of cellular tissue, the stem, and the ribs of their fronds, being formed of more elongated cells than the rest.

No plant, however magnificent in size, splendid in its flowers, or fragrant in perfume, can exceed in beauty, delicacy, and complexity, the humblest moss that grows on an old wall.

3. Lichens are stemless, leafless plants, consisting of a tough wrinkled substance, called a *thallus,* coloured of all tints; they grow on the ground, stones, bark of trees, old pales, &c. It is this tribe of plants, which gives that rich colouring to these objects, which delights the eye of the artist: there are nearly 2500 different species.

Their organs of reproduction are *sporules,* enclosed in the substance of the plant, but even small portions of it, when detached, are capable of producing new individuals;—*Ex:* the Iceland moss is a lichen, as is, also, the tripe de roche, on which the Canadian hunters are obliged so often to subsist.

4. Fungi are plants hardly admitting of description: but the principal representatives of them, mushrooms, toadstools, &c., are known to every one: there are upwards of 5000 species described. They are remarkable for the singular rapidity of their growth, and for their perishable nature.



One species (Bovista giganteum) has been known to grow from a point to the size of a large gourd in the course of one night; it has been calculated that the cells of which its substance consisted, must have multiplied at the rate of sixty-six millions per minute; but great obscurity and mystery attend the production and mode of propagation of Fungi.

Some species are innocent; others are violent poisons. They grow on fields, in woods, on old decayed timber, and on most animal or vegetable substances when decaying: the dry-rot in timber, smut in wheat, mildew, and mould of all kinds, are fungi; the champignon, mushroom, truffle, and many others, are articles of food.

5. Algæ are aquatic plants, growing either in fresh or salt water. The latter are sea-weeds; they consist of fronds, which increase indefinitely in length and direction, though preserving the same figure.

These are the simplest of all plants, as regards their structure and mode of propagation; and it is by them that the two great divisions of organized beings, animals and vegetables, are linked together.

There are aquatic *animals* which, fixed to rocks and stones, are destitute of the power of motion, and resemble the species of sea-weeds called nostocs, in the simplicity of their structure, and the manner in which they multiply; and one tribe of sea-weed, called zocarpæ, produces real *animalculæ*, which again unite into a filamentous plant.

GENERAL OBSERVATIONS ON VEGETATION.

An analogy between vegetable and animal irritability has been proved, by the fact of mineral and vegetable poisons producing analogous effects on both the divisions of organic bodies; but this subject cannot be entered into in an elementary work.

In the description of the leaves, instances were mentioned of voluntary motion, proving the existence of vitality and irritability; but now that the various organs of plants have been described, some more examples will be given, which are interesting as proofs of the care apparent in all the works of Nature for the preservation of the individual, and for the continuance of the species.

In many plants, the leaves close together over the flowers at night, as if to shelter these important organs from the cold; while the flowers of many shut up their corollas in cloudy weather, and expand them only in sunshine. The evening primrose, and some *Cacti*, unfold their blossoms at the approach of evening, which wither at the return of day.

But still more obvious signs of irritability are shown in the organs of reproduction; if the stamens of the common berberry are touched with a needle, or any sharp body, they spring up against the pistil, and an equal degree of irritability is shown by those of the common wall pellitory.

The fruits of many plants burst open with considerable force, for the sake of dispersing the seeds they enclose as far as possible, and thus affording more room for their growth; and, therefore, obviating that waste of seeds which takes place when they simply drop on the ground, and lie too close together to admit of their all thriving.

This phenomenon is particularly striking in the spirting-cucumber (Momordica elaterium), which, when ripe, expels its stalk, seeds, and juice, with considerable force; in the touch-me-not (Impatiens noli-me-tangere) the same thing is observable of the seeds; and many similar facts might be mentioned of other plants.

The only obstacles to vegetation are, extremes of either cold or heat, and absolute privation of air and light; and consequently, plants of some sort are found on every portion of the earth's surface, as well as at the bottom of ponds, lakes, rivers, and the ocean, to a considerable depth.

But the various species, though endued with the power of accommodating their exterior form, within certain limits, to the peculiar qualities of the situation in which they grow, have each their own proper *station*, as it is called, where alone they are capable of flourishing, and perpetuating their races for ages; and, if transported into a very different one, they soon languish and die.

Thus some species always grow, or only thrive, on lofty mountains; others in plains; some seek the shade of woods; others live only in marshes. Some grow always under water; and even stagnant water, running streams, rivers, &c., have their peculiar tribes; still more distinct are those of salt, from the inhabitants of fresh, water.

A considerable degree of warmth and moisture is most favourable to vegetation; hence it is, in tropical regions the most magnificent plants are generally to be found.

Those who have resided all their lives in countries like our own, where man has, as it were, forced all nature to minister to his wants and pleasures, and where those plants are alone cultivated or permitted which are of use to him, can form no idea of the luxuriance and splendour of the vegetation of the torrid zone.

The traveller in those regions is never weary of admiring the mass of plants, crowded and mingled together, so varied, and so extraordinary in their forms and productions. Enormous forest-trees, which indicate an age of many centuries, and yet present no signs of decay; lofty palms, contrasting, by their elegant and simple foliage, with all that surround them; climbing plants, which extend their endless stems from tree to tree, now hanging in graceful festoons, loaded with large and brilliant flowers, now trailing on the ground, and forming an impassable barrier, in turn solicit his attention. It is in vain that man endeavours to force a passage through these woods; hatchets are powerless against the hard stems of the giant trees; and if fire be resorted to, the flame is immediately stifled in the thick rank air of the impenetrable mass.

The earth, rendered fertile by the decay of vegetable matter, constantly affords nutriment to new individuals, which spring up to dispute the limited space with their parent plants; while animals, birds, and reptiles, as extraordinary and various as the plants, swarm in the recesses of the forest, safe from the pursuit and molestation of mankind.

In proportion as we recede from the Equator towards the Poles, as the temperature of the air becomes lower, and therefore the atmosphere drier, vegetation diminishes in richness and variety.

In those countries where winter prevails for the greater part of the year, or on the summits of lofty mountains, near the regions of perpetual frost, a small stunted race of plants is found, which are hardly able to flower and ripen their fruits in the short summer they enjoy; even these at last yield to the increasing severity of the cold, and the vegetable kingdom is represented, at this extremity of the scale, by minute mosses and lichens, colouring the surface of the naked rocks, where they are seen among the vast fields of dazzling snow.

But wherever we go, wherever we turn our eyes, whether in the savannahs and forests of South America, or in the barren plains of Tartary; whether we contemplate the enormous baobab and spreading banyan, or examine the smallest fungus that grows on a rotten pale, plants, not less than organized beings of a higher order, are objects of admiration, and sources of instruction and pleasure to a thinking mind.

OF THE CLASSIFICATION OF PLANTS.

Ever since the nature and properties of plants have been studied, it has been found necessary to arrange the numerous species in some order. Different schemes, or *systems*, of such arrangement have been in use at different periods, and have been successively abandoned, from having been found insufficient, or incorrect in principle, as new species were discovered which required classification.

In order to explain, in a clear and simple manner, the principles on which classification is founded, let us suppose that a person possessing a collection of animals, wished to make such a catalogue of them, as would enable any one visiting his *menagerie* to find out the name of each creature. He might first arrange them all in a few great divisions, as quadrupeds, birds, fishes, insects, &c., from their obvious forms; and then he would possibly proceed to subdivide the first set, the quadrupeds, into the *long-haired* and the *short-haired.* In the first of these secondary divisions, he would place the sheep, the Newfoundland dog, the Syrian goat, the polar bear, and so on: in the other would be found the tiger, the fox, the antelope, &c. The length of the hair being *one* very obvious mark, any person, by the help of some further description would be readily able to find from the catalogue which of the animals was called the dog, and which the tiger.

But it might be objected to this arrangement, that though it were easy to find the *name* of each animal, and, therefore, by reference to other books, to learn some particulars of the creature's habits, food, &c., an unimportant circumstance had been made use of for the purpose of forming the classification, the *length of the hair* being liable to variation with change of climate and food; and that animals the most dissimilar in structure and habits had been brought into one class, as, for example, the tiger and the antelope, the horse and the dog; whereas, if the anatomy and food of the several animals had been made the *basis* of the arrangement, without regard to their trifling and variable peculiarities, that though it might at first be more difficult to find out the *name* by a catalogue, yet, when found, more knowledge of the animal would be obtained, by showing what relation it bore to others. Thus the tiger, hyæna, dog, seal, whale, &c., would be found in one great division, as *carnivorous*, or flesh-eating; while the elephant, sheep, camel, and antelope, would be classed in another, as being *herbivorous*, or plant-eating.

The individuals of which the organic creation is made up, are absolutely independent of each other, yet they admit of being arranged in masses, each composed of all those individuals which are perfectly identical in their properties, qualities, and peculiarities of form and structure; to these masses we give the name of *species*. A species may be defined to consist of all the individuals which might be supposed to have descended from one pair, since an individual is only capable of giving birth to others of precisely the same organization in every particular as itself.

If we see a flock of sheep, or a field of wheat, we recognise an assemblage of individuals all belonging to one *species*, however much they may differ in size; no two plants of the corn may have the same number of grains in an ear, and yet we do not hesitate to refer them all to one species, because we know that if the seeds of one plant were sowed, they would produce other plants equally dissimilar in size, but perfectly alike in every other respect.

If, among the sheep, we see one which, instead of having curly wool, had a straight hair-like fleece, and, instead of two, had three horns, or had two spirally-twisted horns, like a corkscrew; or if, among the wheat, we saw a plant resembling it, but having its ear differently formed, we should acknowledge that these strangers were not of the same species as the rest; but finding that in all essentials of structure and habits, they agreed with the individuals of the former species, and especially if we found that the stranger would occasionally breed with some of the others, we should decide on its being an individual of another species, but belonging to the same *genus*.

A genus may be defined to be a collection of all those species which may be induced to breed together, and give rise to a progeny partaking of the peculiarities of both its parents, but incapable of continuing this new race; or, more comprehensively, a genus contains those species which agree in all particulars of organization, &c.

But the number of genera under which the known species of plants are arranged are so numerous, as to require further classification for facility of reference. If one or two points of difference only are made the characteristics of these more comprehensive groups of genera, the system is an *artificial* one, and of such, the celebrated LINNÆAN, or SEXUAL SYSTEM, is by far the easiest for assisting the memory in recalling different species of plants, and for enabling a beginner to find the *name* of any plant he meets with; but, from its being founded on peculiarities of structure, which are not even constant in different individuals of the same species, and which have little connexion with the physiology of the plants, it frequently causes, as will be shown, the most dissimilar species to be brought into one class or division.

It must be mentioned, that Linnæus himself was aware of this defect, and considered his system as only a temporary one, till increasing knowledge would admit of a better being made, founded on *natural affinities*; this is now, in a great measure, accomplished; and this second system, called that of the NATURAL ORDERS, or FAMILIES, is everywhere employed on the continent; while, in England, though the Linnæan is still used, the former is daily becoming more general, and must soon supplant the Linnæan altogether.

Affinity, as employed in the science of classification, is a relative term; two orders or tribes of plants, animals, &c., are said to be in affinity with each other, if they agree in the greater number of important characters, and the degree of affinity is estimated by the number. Thus, there is the greatest affinity between a dog, a fox, and a wolf, they are species of one *genus;* there is great affinity between a cat and a dog, they belong to two genera of one *order;* there is less between a dog and a goat, and none between a dog and a fish, though they are both vertebrated animals.

The same principles apply to plants, and in every attempt to arrange the numerous species known, the natural affinities ought never to be violated more than is inevitable in a *linear* arrangement, as all tabular ones must be, that is, an arrangement where the genera follow each other in succession. There exists no affinity between a monocotyledonous and a dicotyledonous plant, but little between two dicotyledonous genera, such as Fragaria and Hypericum, which only agree in being polypetalous, with superior ovaria and indefinite stamens, but which differ in the stamens of the former being perigynous, those of the latter hypogynous; the carpella of the former are distinct, and situated on an elevated receptacle, and are only one-seeded; those of the latter are concrete, forming a many-celled ovarium, and are many-seeded; the leaves of the former are alternate and compound; those of hypericum are simple, opposite, and glandular. The former are innocent generally, and the fruit wholesome, the latter are deleterious; and equal differences prevail in other respects; hence these two genera are not *in affinity,* since the points of difference are far more numerous than those of agreement. But if an apple-tree is compared with a strawberry, they will be found to agree in the greater number of essential *botanical* characters, though they differ in a few others which give them a distinct character *to the eye;* they are both polypetalous, with indefinite perigynous stamens, the carpella are *few*-seeded, the embryo is straight, with no albumen, the leaves are alternate, stipulate, and compound; the properties are similar; the first obvious disagreement is between the ovaria, the carpella of the apple being enclosed in the calyx, and concealed in the ripened fruit by the extraordinary developement of that organ, instead of lying promiscuously on a highly developed receptacle; and in consequence the two genera have been placed in two distinct *orders,* or groups of genera, which have the closest affinity to each other.

The magnitude of the plant, or the form of its flowers, leaves, &c., is of no importance in a physiological point of view. The tribe to which the common mallow belongs, is one of the best defined of all, and presents the fewest exceptions; it is botanically characterized as being, *dicotyledonous, polypetalous, having hypogynous monadelphous stamens, concrete carpella, forming an ovarium of several cells, with the placentæ in the axis; the calyx has a valvate æstivation; the anthers are one-celled, and burst longitudinally; the flowers have no disk; the leaves are alternate and stipulate; and the hairs are stellate; the seeds are without albumen; the plants are mucilaginous, and perfectly innocent.*

There are a few exceptions from these characters in some genera of the order; thus, the malope, so favourite a flower in our gardens, has its carpella distinct, and arranged promiscuously round an elevated conical receptacle, instead of having a regular carcerule, (see p. 69.) but in *every other* particular it agrees with the lavatera and the mallow, &c. Now, a plant having all the above characters, except that its stamens are polyadelphous, is naturally referred to the order, though it is the largest tree in the world, with great leaves, and a stem twenty or thirty feet in diameter,—such is the *adansonia;* and yet the polyadelphous stamens is a much less important distinction between this tree and the humble herbaceous mallow, than the distinct carpella of the *malope* is between that genus and the *lavatera,* which it so much resembles in size, port, and every external character.

The animal kingdom offers analogous characteristic differences; no one doubts the affinity between the gigantic crocodile and a water-newt, and every one perceives that none exists between the crocodile and great manis, or ant-eater, which is of the order *Edentata,* and class *Mammalia,* though it has the hard scaly skin and long tail of the former animal, belonging to the class Reptile, and is of about the same size.

By reflecting on these considerations, the learner will be enabled to appreciate the two systems alluded to, and will feel convinced, that if he do not at once adopt and master the natural one, but rests content with the artificial, his botanical knowledge will be of the most superficial kind—he will learn *names,* and not *things and their properties.*

THE LINNÆAN SYSTEM.

According to this system, plants are divided into twenty-four *classes,* each consisting of two, or more

The first eleven are founded on the *number of the stamens;* the orders on the *number* of the styles, or of the stigmas, if the styles are united.

The twelfth contains plants, with perigynous stamens, and *not more than twenty in number.*

The thirteenth, those with hypogynous stamens, and *more than twenty in number.*

The fourteenth contains those plants which have *didynamous stamens;* the orders founded on the *structure of the fruit.*

The fifteenth contains plants with *tetradynamous stamens:* the orders being founded on the *form of the fruit.*

The sixteenth, seventeenth, and eighteenth classes contain *monadelphous*, *diadelphous*, and *polyadelphous* plants; the orders depending on the *number of the anthers.*

The nineteenth class contains plants with *syngenesious anthers;* the orders of this large class are founded on the circumstance of the florets of the capitule being hermaphrodite, and unisexual, variously combined in the disk and ray.

The twentieth class contains those plants which are *gynandrous*, or have their stamens and pistils united: the orders depending on the *number of the anthers.*

The twenty-first and twenty-second consist of *monœcious* and *diœcious* plants, or those which have unisexual flowers on the same, or on two separate individuals; the orders arising from either the number of the stamens, or from their being mona-dia-delphous, or syngenesious.

The twenty-third consists of *polygamous* plants, or those which have hermaphrodite and unisexual flowers on *one*, *two*, or *three* individuals; the orders being founded on this.

The twenty-fourth class comprises all flowerless or cryptogamous plants.

In page 113 is a tabular view of the Linnæan classes.

The names of the classes and orders are derived from the Greek, and express the circumstance on which they are founded.

We shall now give an example or two of a few of the orders of each class, that the learner may better understand the system.

Class

1. Monandria (one stamen). Two orders. 1. *Monogynia* (one style);—*Ex:* Indian-shot, arrow-root, ginger, glasswort, &c. 2. *Digynia* (two styles);—*Ex:* water-starwort, strawberry-blite.
2. Diandria (two stamens). Three orders. 1. *Monogynia:* olive, privet, lilac, jasmine, speedwell, sage, cladium, &c. 2. *Digynia:* one of the grasses. 3. *Trigynia* (three styles): pepper.
3. Triandria (three stamens). Three orders. 1. *Monogynia:* valerian, commelina, crocus, iris, corn-flag, club-rush, papyrus, &c. 2. *Digynia:* all the grasses, but one genus. 3. *Trigynia:* all-seed.
4. Tetrandria (four stamens). Three orders. 1. *Monogynia:* Proteaceæ, pothos, ladies'-mantle, teasol, scabious, wood-ruff, wall-pellitory, &c. 2. *Digynia:* dodder. 3. *Tetragynia* (four styles): holly, pond-weed.
5. Pentandria (five stamens). Six orders. *Monogynia:* heliotrope, borage, cyclamen, henbane, convolvulus, tobacco, primrose, heliconia, strelitzia, &c. *Digynia:* Umbellaceæ. *Trigynia:* elder, bladder-nut. *Tetragynia:* parnassia. *Pentagynia* (five styles): flax, sundew, thrift, &c.
6. Hexandria (six stamens). Four orders. *Monogynia:* narcissus, sweet-flag, rush, tradescantia, aloe, lily, tulip, garlic, berberry, &c. *Digynia:* rice. *Trigynia:* meadow-saffron, sorrel.
7. Heptandria (seven stamens). Four orders. *Monogynia:* horse-chestnut, winter-green (Trientalis-europæa, the only British plant of the class), dracontium.
8. Octandria (eight stamens). Four orders. *Monogynia:* tropæolum, evening-primrose, fuchsia, French willow

Class

heath, cranberry, &c. *Trigynia:* buck-wheat. *Tetragynia:* paris, &c.

9. ENNEANDRIA (nine stamens). Three orders. *Monogynia:* laurel, &c. *Trigynia:* flowering-rush, (the only British species.) The whole class only contains six genera.

10. DECANDRIA (ten stamens). Five orders. *Monogynia:* many genera of Leguminosæ, mahogany, Venus's fly-trap, rhododendron, &c. *Digynia:* saxifrages, pink, soapwort, hydrangea. *Trigynia:* catch-fly, sand-wort, &c. *Pentagynia:* wood-sorrel, sedum, lychnis.

11. DODECANDRIA (twelve stamens). Six orders. *Monogynia:* mangrove, &c. *Digynia:* agrimony. *Trigynia:* mignonette, euphorbia. *Dodecagynia* (twelve styles): house-leek.

12. ICOSANDRIA (from twelve to *twenty* perigynous stamens). *Monogynia:* cactus, clove, myrtle, pomegranate, eucalyptus, almond, plum, &c. *Di-pentagynia* (two to five styles): apple, quince, medlar. *Polygynia* (many styles): rose, bramble, strawberry.

13. POLYANDRIA (more than twenty hypogynous stamens). Four orders. *Monogynia:* poppy, water-lily, lime-tree, rock-rose, &c. *Di-trigynia* (two or three styles): pæony, larkspur, aconite, &c. *Pentagynia:* columbine, nigella, &c. *Polygynia:* magnolia, anemone, ranunculus, &c.

14. DIDYNAMIA. Two orders. *Gymnospermia* (*naked seeds*, fruits, mistaken for such by Linnæus, but really a carcerule, the carpella forming which are separate from each other): Labiatæ. *Angiospermia* (fruit, a capsule): honeysuckle, bignonia, penstemon, acanthus, vervain, cow-wheat, broom-rape, snap-dragon, linaria, mimulus, maurandya, foxglove, &c.

15. TETRADYNAMIA. Two orders. *Siliquosa* (fruit, a siliqua): *Siliculosa* (fruit, a silicula): Cruciferæ, cleome.

16. MONADELPHIA. Seven orders. *Triandria:* tamarind, tigridia, &c. *Pentandria:* passion-flower, crane's-bill, &c. *Heptandria:* stork's-bill. *Decandria:* Geranium.

Class

Polyandria: malva, hollyhock, cotton-tree, baobab, camellia, &c.

17. Diadelphia. Four orders. *Hexandria:* corydalis. *Octandria:* polygala. *Decandria:* Leguminosæ.

18. Polyadelphia. Two orders. *Decandria:* cacao, &c. *Polyandria:* St. John's-wort, orange, lemon, loasa.

19. Syngenesia. Five orders. *Æqualis* (florets of the disk, all hermaphrodite, *equal*, lat.): goat's-beard, leontodon, &c. *Superflua* (florets of the disk, hermaphrodite, those of the ray, female, *superfluous*): daisy, groundsel, dahlia, aster, &c. *Frustranea* (florets of the disk, fertile, of the ray, sterile, *useless*, lat.): sun-flower, centaury, &c. *Necessaria* (florets of the disk, male, those of the ray, female, and fertile): calendula, cotton-rose, &c. *Segregata* (each floret having its own involucre, *separated*, lat.): echinops.

20. Gynandria. Three orders. *Monandria:* Orchidaceæ. *Diandria:* Orchidaceæ. *Hexandria:* aristolochia.

21. Monœcia. Eight orders. *Monandria:* bread-fruit, casuarina. *Diandria:* duck-weed. *Triandria:* cat's-tail, bur-reed, carex, and coix, Indian-corn, and others of the grasses, &c. *Tetrandria:* alder, birch, box, nettle, mulberry, aucuba, &c. *Pentandria:* amaranth. *Hexandria:* cocoa-nut, sago, and some other palms. *Polyandria:* horn-wort, water-milfoil, begonia, burnet, hornbeam, beech, hazel, walnut, oak, caladium, &c. *Monadelphia:* areca, pine, larch, fir, arbor-vitæ, momordica, gourd, cucumber, briony, croton, castor-oil plant.

22. Diœcia. Thirteen orders. *Monandria:* pandanus. *Diandria:* willow, &c. *Triandria:* crow-berry, date-palm, &c. *Tetrandria:* mistleto, Dutch-myrtle. *Pentandria:* spinach, hop, hemp. *Hexandria:* black-briony, yam. *Octandria:* poplar. *Enneandria:* dog's-mercury, &c. *Decandria:* papaw-tree, &c. *Dodecandria:* water-soldier, &c. *Polyandria:* cycas, zamia, cliffortia. *Monadelphia:* butcher's-broom, yew, juniper, nutmeg, nepenthes, &c.

23. Polygamia. Two orders. *Monœcia:* mimosa, acacia,

Class

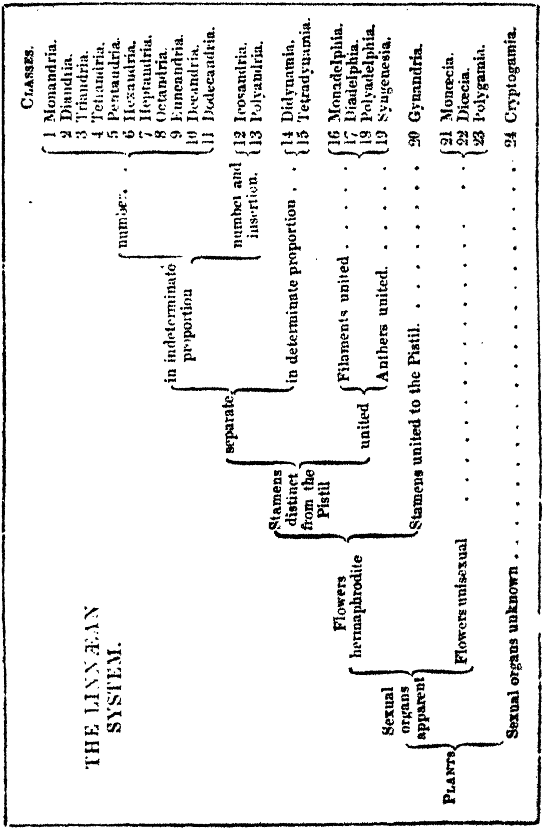
several of the grasses, pellitory, orache, maple, clusia, &c. *Diœcia:* chamærops, ash, fig-tree, &c.

24. Cryptogamia. Nine orders. Ferns, horse-tail, club-moss, pill-wort, mosses, jungermannia, Algæ, Lichens, Fungi.

It will be seen from the foregoing examples of the different orders of the Linnæan classes, that this system is essentially *artificial*, and that, consequently, plants the most dissimilar are frequently arranged under the same class and order; while, on the contrary, plants having the most intimate natural affinity, are to be found in different orders and even classes.

Thus, for example, in the first order of the first class, monocotyledonous and dicotyledonous plants are found, as the arrow-root and glass-wort; and the same anomaly occurs in the first order of the second class, which contains the monocotyledonous genus, cladium, along with such very different plants as the wild tamarind, the olive, jasmine, speedwell, and sage. Anthoxanthum, one genus of the grasses, is found in the second class, from having only two anthers, while most of the others belong to the third; in the first order of which, Lœflingia, Valerian, Commelina, and Crocus, are found; the two latter being monocotyledonous, and the former dicotyledonous. Innumerable other examples of similar inconsistencies might be given, throughout all the classes and orders.

It must be remarked, too, that such inconsistencies are inherent in any artificial system, since they exist even in the Linnæan, the most perfect of all; though repeated endeavours have been made, by correcting and rearranging the orders, to render it, as much as possible, conformable to the natural affinities of species.


THE LINNÆAN SYSTEM.
PLANTS
Sexual organs apparent
Flowers hermaphrodite
Stamens distinct from the Pistil
separate
in indeterminate proportion
number
number and insertion
in determinate proportion
united
Filaments united
Anthers united
Stamens united to the Pistil
Flowers unisexual
Sexual organs unknown
CLASSES.
1 Monandria.
2 Diandria.
3 Triandria.
4 Tetrandria.
5 Pentandria.
6 Hexandria.
7 Heptandria.
8 Octandria.
9 Enneandria.
10 Decandria.
11 Dodecandria.
12 Icosandria.
13 Polyandria.
14 Didynamia.
15 Tetradynamia.
16 Monadelphia.
17 Diadelphia.
18 Polyadelphia.
19 Syngenesia.
20 Gynandria.
21 Monœcia.
22 Diœcia.
23 Polygamia.
24 Cryptogamia.

THE NATURAL ARRANGEMENT.

The learner, whose mind is imbued with the *spirit* of the observations given in a former page, on the natural arrangement of plants, will at once perceive that there can be no permanent well-defined divisions; and that no two botanists may agree, even on the primary and general ones, since each may consider different characters on which these divisions are to be founded, as entitled to priority. The scheme of arrangement here presented to him is that which has been promulgated by one of the first botanists in this country*, as most accordant with our existing knowledge of the science.

The whole vegetable kingdom is divided into five principal classes, the four first containing those plants which are propagated by means of a sexual apparatus, or which are *phænogamous;* the last contains *cryptogamous* plants, or those which multiply without distinct, or apparent, flowers

Class

1. Exogenæ, have vascular tissue and spiral vessels, their seeds are contained in an *ovarium*, their leaves are *reticulated*, the floral parts have a *quinary arrangement*, their embryo is *dicotyledonous*, and their germination is *exorhizal.*
2. Gymnospermæ, form an intermediate class, and differ from the former in their imperfectly vascular tissue, their parallel or forked-veined leaves, and the absence of an ovarium.
3. Endogenæ, have a vascular tissue and spiral vessels, their seeds contained in an *ovarium*, their flowers being perfect; their leaves have *parallel* veins, the floral parts have a *ternary* arrangement, their embryo is *monocotyledonous*, and the germination *endorhizal.*

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* Dr. Lindley, in his *Nixus Plantarum*, and other works.

Class

4. RHIZANTHEÆ, form another intermediate class, and differ from the foregoing in having *cellular* tissue, only imperfect spiral vessels, no leaves, distinct but imperfect sexual apparatus, and *acotyledonous* embryo.
5. ACROGENÆ, have *cellular* tissue chiefly (rarely vascular), leaves or fronds with a forked venation, or entirely leafless, no flowers, and *acotyledonous* embryo.

Exogenæ are divided into three sub-classes:

1. POLYPETALÆ, containing those plants which have the petals of the corolla separate, and two verticils of floral envelopes, or if only one, the calyx being highly developed.
2. An intermediate sub-class, containing achlamydeous plants; or if a calyx be present, it is but imperfectly developed; or else, if there are two or more verticils of floral envelopes, they are herbaceous in texture.
3. MONOPETALÆ, containing those plants which have the petals of the corolla united into a tube at their base.

These sub-classes are again resolved into several *groups*, each group being characterized by one or two important points of structure. The groups are further subdivided into *alliances*, containing those orders which agree in the principal points of structure, &c. Orders are collections of genera, and bear the same relation to them that genera bear to species.

The other four classes do not require division into sub-classes, but are arranged at once in groups and their subordinate sections.

To give an example or two of the principles of this natural system:—the common buttercup is the SPECIES *acris* of the GENUS *Ranunculus* of the ORDER *Ranunculaceæ;* which order is characterized by having its floral envelopes in fives, and by having its sap colourless.

The common corn-poppy is the species *rheas* of the genus *Papaver*, of the order Papaveraceæ, which order is characterized by having a binary division of its floral envelopes, and its sap milky.

But the two orders, Papaveraceæ and Ranunculaceæ, belong, with a few others, to an *alliance* termed RANALES, comprising *herbaceous plants with apocarpous fruits, or with parietal placentæ.* Another alliance, termed UMBELLALES, comprise herbaceous plants having epigynous flowers arranged in umbels and fistular stems.

These two, with four other alliances, form the first group ALBUMINOSÆ of the sub-class Polypetalæ. This group being characterized by an abundance of albumen in the seed of all the plants contained in its various subdivisions. The four other groups which combine with it to form the sub-class, are each distinguished by some one essential character. But so intricately interwoven are all the genera of plants, and so utterly impossible is it to refer them to well-defined comprehensive sections that do not admit of any exception to the character belonging to it, that every one of the genera, orders, alliances, groups, sub-classes, and even classes, pass into one another by some intermediate genus which possesses a character of each section, and it is in referring these doubtful genera to neighbouring sections, or in striving to frame these sections so as to avoid as much as possible these refractory genera, that leading botanists differ.

Until the relative consequence of the different organs of plants is better ascertained, it is impossible to know the degree of importance of any peculiarity of structure; whether it ought to be considered the result of a particular mode of organization, and therefore constant; or, as dependent for its existence on the mode of vegetation only of the species, and therefore liable to variation.

Botanists have, accordingly, been compelled to augment the number of orders, to prevent the necessity of classing in the same, plants which differed in particulars, the relative consequence of which they could not ascertain. At present the number of orders amounts to about three hundred and twenty, many of which consist of one genus only, and some of them contain more than a hundred genera. Such comprehensive orders require subdivision, for the purposes of classification; and, in some cases, this subdivision is founded on minutiæ of structure, which cannot be ascertained without a microscope and a dissecting-knife.

Thus, the subdivisions of Cruciaceæ depend on the position of the radicle and cotyledons, in the embryo, and this must be ascertained in seeds smaller than those of stocks, &c.

This liability to fluctuation, and to indefinite extension, is the principal objection to the system of natural orders; but if one of the objects of all classification, that of an assistance to the memory, is in some measure sacrificed, the importance of all natural arrangements in science, in a philosophical point of view, more than atones for this defect.

The names of these natural orders are formed from that of the principal genus, by adding to it the syllable ceæ: thus the name of the natural order Magnoliaceæ is formed from Magnolia. If the generic name end in a consonant, some change is made in its termination, so that the name of the order derived from it shall end in aceæ, thus, the order Myrtaceæ is formed from Myrtus, Linaceæ from Linum, &c.

But, in several cases, the name of the natural order is expressive of some peculiarity in the genera which compose it, as Leguminaceæ, from the fruit, a *legume*, which the plants of that order bear; Umbellaceæ, from the inflorescence of the plants composing that order; Cruciaceæ and Stellaceæ, from the form of the flower; and so of others.

It would be useless to give the names of all the orders in an elementary work, as these alone would convey no information, and would mislead the beginner as to the true nature of this system, which does not, properly, admit of any arrangement of the orders in succession; each of them being allied to many others, from all but one or two of which it must be separated by such an arrangement. And these affinities, so essential to the *spirit* of the *natural system*, can only be learnt by long study and observation.

To give the learner some idea of the manner in which *orders* of plants are described, a short account* of a very few is added; he will thence become acquainted with the application of terms, and will learn, from the mention made of the geography, station, and uses of each order, in what way botany is now applied, and how important a general knowledge of it is to most persons.

Among these orders, the learner will find two sub-orders, Pomeæ, Amygdaleæ, very nearly related to each other, and which, till lately, were included in a more comprehensive one, namely, Rosaceæ; by comparing these, he will see on what differences of structure separation of orders in the *natural system* takes place, and will thus gain an insight into the kind of difficulties he will have to contend with, in studying the science.

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* Principally abridged from Professor Lindley's *Introduction to the Natural System of Botany.*

CLASS I.—EXOGENÆ.

Sub-class, POLYPETALÆ; Group, *Albuminosæ;* Alliance, *Umbellales.*

UMBELLACEÆ.—*Calyx* superior, entire or five-toothed, often obsolete; *petals* inserted on the outside of a fleshy disk, *æstivation* imbricate; *stamens* five, alternating with the petals; *ovarium* inferior, two-celled, two-seeded, crowned by a double fleshy disk, two distinct styles, with simple stigmata; *fruit* a cremocarp, of two carpella; *seed* usually adhering to the pericarp; *embryo* minute, at the base of a horny albumen, radicle pointing to the hilum. *Herbaceous plants,* with fistular furrowed stems, *leaves* usually divided, and sheathing; *inflorescence* an umbel, generally surrounded by an involucrum.

Chiefly found in northern climates, and much more abundant in the old, than in the new world; *station,* groves, thickets, marshes, and waste places; forty-two genera are natives of Britain.

Many plants in this order are highly poisonous, and from the resemblance of the leaves, &c., of different species, fatal mistakes have been made; hemlock, fools'-parsley, water-dropwort, water-parsnep, and cow-bane, may be cited as poisonous species, indigenous to our own country. Yet many genera, especially when cultivated, afford wholesome and pleasant food, as the carrot, celery, parsley, samphire, skirret, parsnep, earth-nut. The *fruit* of the whole tribe is innocent and aromatic, as caraway, coriander, &c. Opoponax, asafœtida, gum-ammoniac, and galbanum, used in various ways as medicine, are obtained from plants of this order.

Principal Genera:—Pastinaca, Daucus, Conium, Sanicula, Crithmum, Smyrnium, Hydrocotyle, Astrantia, &c. The genera Eryngo and Didiscus, are singular for having *blue* flowers, white being the common colour, and but few yellow.

Group, *Parietosæ;* Alliance, *Cruciales.*

CRUCIFERÆ.—*Calyx* inferior, of four deciduous sepals; *æstivation* imbricate; *petals* four, alternate with the sepals; *stamens* six, tetradynamous, the two shorter lateral with respect to the axis; *disk* with green glands; *ovarium* superior, unilocular, with parietal placentæ, usually forming a false dissepiment, with two stigmata opposite them; *fruit*, a siliqua or silicula, dehiscing by two valves separating from the replum, or indehiscent; *seeds* hanging alternately to each of the placentæ, without albumen, radicle folded on the cotyledons in various ways. *Herbaceous plants*, seldom shrubby ones, and either annual, biennial, or perennial, with alternate leaves, flowers generally either yellow or white; *inflorescence* various.

Principally European, but also found in most other parts of the world; 640 species belonging to the temperate zones, 220 to the frigid, and only 30 to the tropics, and those in mountainous regions. Thirty-three genera are indigenous to our country. *Stations* very various, sea-side, marshes, ponds, waste-ground, old walls, and open plains.

The plants of this order are uniformly innocent, though often pungent; they contain a great deal of *azote*, a chemical *principle* more peculiar to animal than vegetable bodies; hence arises the fœtid smell of these plants when decaying. Mustard, cress, horse-radish, turnips, cabbage, brocoli, sea-kale, cauliflower, water-cress, &c., are used as food, and are considered antiscorbutic; the scurvy-grass, one of the horse-radish genus, receives its name from this property. Except mustard-seed, used unground in some cases, few medicines are derived from Cruciaceæ. The seeds generally abound in oil, extracted from some species by grinding, for use in arts and manufactures, as for example rape-seed oil.

Principal Genera:—Cheiranthus, Nasturtium, Lunaria, Cochlearia, Brassica, Sinapis, Raphanus, Crambe, &c. &c.

Group, *Apocarposæ*; Alliance, *Rosales*.

Rosaceæ.—*Calyx* with four or five teeth, the odd one posterior or next the axis, with a disk lining the tube, or surrounding the orifice; *petals* five, equal, perigynous; *stamens* indefinite in number, inserted into the calyx within the petals; *ovaria* superior, sometimes solitary, one-celled, either distinct, or, in some genera, cohering into a many-celled pistil, styles lateral, and stigmata simple; *fruit* either a cynarrhodum, an etærio, or follicular; *seeds* suspended, embryo pointing to the hilum, hardly any albumen; *herbaceous plants* or *shrubs*, leaves alternate, compound, with two stipulæ.

Chiefly found in temperate or cold northern climates; very few within the tropics, or in the southern hemisphere: fourteen British genera.

The whole order is innocent; the plants generally contain an astringent principle, which renders some of them useful medicinally, and others for tanning; but they are more known as beautiful flowers; the strawberry, raspberry, blackberry, &c., are pleasant and wholesome fruits.

Principal Genera:—Potentilla, Fragaria, Rosa, Rubus, Spiræa, Brayera, Dryas, Comarum, &c. &c.

SUB-ORDER POMEÆ—differing from the last, principally, in the adhesion of their ovaria to the sides of the calyx, and to each other; *fruit* a pome; *seeds* ascending, and not pendulous, and placed when there are two, side by side, and not over each other, as they are in Rosaceæ; *trees* or *shrubs* with alternate, stipulate, compound, or simple leaves; *inflorescence* terminal cymes, flowers white or pink.

Entirely in the northern hemisphere, with the exception of one species in the Sandwich Islands. Four genera in Britain.

The fruit wholesome and agreeable; the apple, pear, medlar, quince, service, are examples; while the wood of the pear and beam-tree are used for different purposes; and the bark of one genus, Photinia, is employed as a scarlet dye in the East; the common hawthorn, the fruit of which is the haw, is known to every one.

Principal Genera:—Pyrus, Mespilus, Cydonia, Cotoneaster, Amelanchier, &c.

SUB-ORDER AMYGDALEÆ.—*Calyx* deciduous; *ovarium* solitary, superior, one-celled, with two pendulous ovula; *fruit* a drupe; *trees* or *shrubs*, leaves simple and stipulate, but in other respects agreeing with Rosaceæ.

Like the last orders, confined to northern climates, with the exception of one species found in the West Indies, and another in Mexico, on hot dry plains.

Less innocent than Rosaceæ and Pomeæ, to which they are so closely allied, from abounding with hydrocyanic acid chiefly found in the leaves and seeds, and to such an extent in some species, as to be fatal to animals which chance to eat them. The fruits, the almond, peach, cherry, and plum, are delicate, though not very wholesome food; the leaves of the sloe (Prunus spinosa), and the wild cherry (Cerasus avium), are sometimes used to adulterate tea, and, from a variety of the last, the celebrated liquor, called kirschen-wasser (cherry-water), is prepared. The bark of several species is medicinal.

Principal Genera:—Prunus, Cerasus, Amygdalus.

LEGUMINACEÆ.—*Calyx* five-toothed, inferior, the odd segment anterior, or farthest from the axis; *corolla* papilionaceous, rarely regular; *stamens* definite or indefinite, perigynous, either distinct, monadelphous, or diadelphous; *ovarium* superior, one-celled, many-seeded, style and stigma simple; *fruit* a legume, or rarely, a drupe; *seeds* occasionally with an arillus; embryo, exalbuminous, cotyledons, either remaining under-ground or appearing above, in germination; *herbaceous plants*, *shrubs*, or *large trees*, with alternate stipulate compound leaves; leaflets also stipulate; *inflorescence* usually axillary, but various.

This order is allied to a great many others; and, in studying these relations, botanists have derived a considerable accession to their knowledge of the natural affinities of plants. Its very intimate connexion with Rosaceæ is all that can be here pointed out: *physiologically* considered, the difference of the position of the odd segment of the calyx is the only one by which the two can be distinguished. One genus of this order, Detarium, has a drupe for its fruit, and Mimosa has a perfectly regular corolla; in consequence of these anomalies, the order is now subdivided, and there are three sub-orders formed out of it beside the principal one.

They are found in all parts of the world, but very unequally divided; 1600 species growing in the tropics, 1300 in the northern temperate, and 500 in the southern temperate zone. Twenty genera are British.

This extensive order is not less important to mankind, generally, for its utility or beauty, than interesting to the botanist. The pea, bean, harico, vetch, liquorice, clover, saintfoin, lucerne, &c., are cultivated as food, either for man, or for animals in his service; the tamarind, when preserved, is a well-known sweetmeat. Logwood and the rose-woods, Brazil, and the locust-tree woods, as they are termed, are useful and beautiful timber. Indigo, the most important of all dyes, gums—arabic, tragacanth, kino, dragon, lac, and numerous medicinal drugs, of which senna is the most noted, are produced from species of Leguminosæ.

Generally, the order is innocent, if not wholesome; but some genera are very dangerous; the seed of one species (the chickling-vetch) of the sweet-pea genus, is employed on the continent to mix with corn, and when used in too great a quantity, produces a paralysis of the limbs, so that in some countries its use is forbidden. The seeds of the laburnum, and the roots of some sensitive plants, and many other genera, are also poisonous. The tonquin-bean, so well known for its fragrance, is the seed of Dipterix odorata. The bark of some species of Acacia is becoming of importance in commerce for tanning.

For beauty, the large scarlet racemes of the Amherstia nobilis are almost unrivalled, while the sweet-pea, cercis, glycine, sophora, clitoria, and a multitude of others, ornament our gardens and hot-houses; and the commons of our native country are made lovely by the humble and well-known gorse and broom.

Principal Genera:—Pterocarpus, Phaseolus, Stizolobium, Pisum, Vicium, Lathyrus, Acacia, Cytisus, Hedysarum, Medicago, Indigofera, Trifolium, Spartium, Ulex, Genista, &c.

Group, *Syncarposæ;* Alliance, *Euphorbiales.*

EUPHORBIACEÆ, Monœcious or Diœcious.—*Calyx* lobed, inferior, with various glandular appendages, but wanting in some genera; *male flowers* with definite or indefinite stamens, either distinct or monadelphous; *female flowers* ovarium, superior, sessile or stalked, two, three, or more celled, one or two ovules in each; styles as many as the cells, in some separate, sometimes combined, and in others wanting; *fruit* of two, three, or more cells, separating with elasticity from a common axis; *seeds* with an arillus, embryo enclosed in a fleshy albumen; *trees*, *shrubs*, or *herbaceous plants*, often abounding with an acrid milky juice, leaves either opposite or alternate, rarely compound, and commonly stipulate; *inflorescense* axillary or terminal, usually with bracteæ, enclosed within an involucrum.

This order is very puzzling to beginners, who frequently mistake its two or three-leaved involucrum for a calyx, and are surprised to find two or three distinct pistilla enclosed within it; it is, hence, a very instructive object of study to learners.

This is a very extensive order, abounding in tropical America, and at the Cape of Good Hope, where the genera resemble cacti in appearance, but have no other relation to them*; there are only three genera, containing sixteen species, in Britain.

The order affords little food to man, except cassava, prepared from the root of the Jatropha manihot; but there are few from which he derives so many medicinal substances; of the genera furnishing these Croton, Buxus, Crozophora, Euphorbia, and Ricinus, the latter yielding from its seeds castor-oil, may be mentioned. The caoutchouc, or Indian-rubber, though obtainable from other plants, is produced most abundantly from those of Euphorbiaceæ. The box-tree, as affording a wood now so extensively employed in the fine-arts, would alone entitle it to notice in any *book:* it may be, perhaps, worth mentioning, that the box used as borders to flower-beds is a variety of the same species.

SUB-CLASS, MONOPETALÆ.

Group, *Aggregosæ;* Alliance, *Asterales.*

COMPOSITACEÆ.—*Calyx* superior, closely adhering to the ovarium, its limb either wanting or membranous, feathery or hairy (pappus); *corolla* usually deciduous, either ligulate or funnel-formed, and four or five-toothed, with a valvate *æstivation; stamens* five, alternate with the teeth of the corolla, and syngenesious; *ovarium* inferior, one-celled and one-seeded, style simple, two stigmata distinct; *fruit* a cypsele; *seed* exalbuminous; *herbaceous plants* or *shrubs*, leaves, alternate or opposite, exstipulate; *inflorescence* a capitule, unisexual, or hermaphrodite flowers (florets) inserted on a common receptacle, and surrounded by an involucrum, with or without bracteæ, when present, resembling small scales, and stationed in the receptacle at the base of the florets.

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* In the foreground of Plate I., on the right hand, and in the middle, are seen species of the genus Euphorbia, which may be compared with the cacti near them.

One of the most extensive and easily-recognised orders of plants, and the only one found, without exception, in every part of the known world; but, like all others, in very different proportions. Fifty-two genera, comprising one hundred and thirty-nine species, are British.

For food it presents lettuce, succory, endive, artichokes, scorzonera, salsafy, cardoons, and Jerusalem artichokes: for medicine—chamomile, wormwood, tansy, colt's-foot, leontodon, elecampane, and many others. A narcotic *principle* is found, resembling opium, in one principal section of the order (Cichoraceæ), which has all its florets ligulate; it is for this reason persons find themselves sleepy after eating much lettuce, which belongs to it.

An order of plants (Dipsaceæ), very nearly allied to this, is remarkable for containing the genus of which the fullers'-teasel is a cultivated species.

Principal Genera:—Tragopogon, Scorzonera, Lactuca, Leontodon, Bellis, Senecio, Aster, Sigisbeckia, Helianthus, Dahlia, Zinnia, Carduus, Cynara, and Cnicus.

Group, *Labiosæ;* Alliance, *Labiales.*

LABIATÆ.—*Calyx* tubular, inferior, persistent, with five or ten divisions, the odd segment next the axis; *corolla* hypogynous, monopetalous, bilabiate, the upper lip either whole or bifid, the lower larger, and three-lobed; *stamens* four, didynamous, inserted on the corolla, sometimes two are wanting, anthers liable to great diversities of form and construction; *ovarium* deeply four-lobed, and seated on a fleshy disk, each lobe one-seeded, style proceeding from the base of the lobes, stigma bifid; *fruit* one to four achenia, enclosed in the persistent calyx; *seeds* with little or no albumen; *herbaceous plants,* or *under-shrubs,* stem four-cornered, with opposite ramifications, exstipulate, opposite leaves, with receptacles of aromatic oil; *inflorescence,* opposite axillary cymes, sometimes capitate.

Generally natives of temperate regions; station, dry situations, rarely marshes. Twenty-one genera are British.

This extensive order does not contain a single unwholesome species; many are pleasant tonic, cordial, and stomachic herbs for infusion, or for condiments to food, as savory, mint, basil, sage, ground-ivy, thyme, &c. &c. One singular property possessed, probably, by the whole order, is, that it abounds in camphor, especially in the oils of sage and lavender; besides their utility, many genera are beautiful additions to gardens, as the salvia and others.

Principal Genera:—Lavandula, Mentha, Glechoma, Marrubium, Stachys, Thymus, Ocymum, Scutellaria, Salvia, Prostanthera, &c. &c.

CLASS II.—GYMNOSPERMÆ.

CONACEÆ.—*Flowers* monœcious or diœcious; *males* monandrous or monadelphous, each floret consisting of a single stamen, or of a few united, collected in a deciduous amentum, anthers often terminated by a crest; *females* usually in cones, sometimes solitary; *ovarium* in the cones spread open, resembling a flat scale, without style or stigma, and arising from the axilla of a membranous bractea, in the solitary flower wanting; *ovula* naked, in the cones in pairs on the face of the ovarium, and inverted, in the solitary flower erect; *fruit* either a strobilus, or a single naked seed; *seeds* with a hard integument and embryo, in the middle of a fleshy oily albumen, with two or many verticillate cotyledons; *trees* or *shrubs*, with a branched trunk, abounding in resin, leaves linear or lanceolate, with parallel veins.

Natives of very different climates, but principally of northern temperate ones, as Europe, Siberia, China, and the temperate parts of North America, where the species are most abundant, and the genera very different in aspect from those of the southern hemisphere. There are only five species indigenous in Britain.

There is no order of plants of such universal importance to man as this, both for its timber and for its juices; gigantic in size, hardy, and rapid in growth, they form a considerable portion of every natural wood or artificial plantation. One species in New Zealand (Dammara australis) attains a height of 200 feet, and yields a light firm wood, free from knots; but the pines of North America are sometimes 230 feet high, or even more; of these, the Douglas pine (Pinus taxifolia) is said to be the most valuable for its timber; the trunks are from two to ten feet in diameter; it is introduced in this country, and is gradually spreading by cultivation.

Their secretions consist of various kinds of resins; oil of turpentine, common and Burgundy pitch, are obtained from the Scotch pine, and many other varieties of the same resinous fluids from other species. Spruce is obtained from the branches of the hemlock-spruce, a Canadian tree. The bark of the larch is nearly as useful for tanning as that of the oak; and the berries of the common juniper are used for flavouring spirits. The seeds of many species are fit for food, but the fruit of the yew is poisonous.

Principal Genera: Pinus, Abies, Taxus, Juniperus, Larix, Cupressus, Podocarpus, Araucaria, Dacrydium, &c.

The other orders belonging to Gymnospermæ are Cycadaceæ, formed of two genera only; Cycas and Zamia, resembling palms in appearance, but both exogenous and dicotyledonous. Equisetaceæ are acotyledonous, and have only imperfect sexual organs; it is one of the transition orders, by which the great classes are connected.

CLASS III.—ENDOGENÆ.

Group, *Gynandrosæ.*

ORCHIDACEÆ.—*Perianth* superior, sepals three, usually coloured, the odd one uppermost, from the twisting of the ovarium; *petals* three, usually coloured, of which two are uppermost, from the same cause, and the other, called the lip (labellum), is usually lobed, and differs in form, colour, or size from the rest, and is often spurred (see p. 51); *stamens* three, united in a central column (gynandrous), the two lateral usually abortive, and the central one perfect, or just the reverse; anther either persistent or deciduous; pollen either powdery or cohering in granular or waxy masses; *ovarium* one-celled, with three parietal placentæ; style forming part of the column of the stamens; stigma a viscid space in front of the column; *fruit* usually a capsule, dehiscing by three valves, sometimes baccate; *seeds* numerous, testa loose and reticulated, no albumen, embryo a solid undivided fleshy mass; *herbaceous plants*, either stemless, or forming a kind of tuber above-ground, or sometimes with a true stem; roots, in the herbaceous species, fleshy, divided, entire or fasciculate; leaves simple and entire, sometimes articulated with the stem;

inflorescence terminal or radical spikes, racemes or panicles, occasionally solitary.

Natives of almost all countries, except very cold or very dry; station, moist shady places, meadows or marshes; most abundant in hot damp places in South America, East and West Indies, and tropical islands; there are thirty-seven British species:—there are, probably, not less than fifteen hundred species altogether.

Though interesting to the botanist for their anomalous structure, and to all lovers of nature for their beauty, these plants are of little *use*, in the vulgar meaning of the word; for, except salep, which is prepared from the roots of the Orchis mascula, and vanilla, which is the fruit of a West Indian species, used in flavouring chocolate, man derives neither food, clothing, nor medicine from them; but that mind must be very uncultivated that is not touched by the fairy-like appearance, and the silent *poetical* retreats of this lovely order.

Principal Genera:—Spiranthes, Epipactis, Ophrys, Dendrobium, Renanthera, Cypripedium, Oncidium, Orchis, Corallorrhiza, &c., &c.

Group *Glumosæ.*

GRAMINACEÆ.—*Flowers* usually hermaphrodite, sometimes monœcious or polygamous, not surrounded by calyx or corolla, but by bracteæ, of peculiar forms and names (see page 54); *glumes* usually two, alternate, usually unequal, sometimes solitary; *paleæ* two, alternate, the outer one simple, the inner one composed of two, united by their edges; *scales* two or three, sometimes wanting; *stamens* hypogynous, one, two, three, four, six, or more in number, anthers versatile; *ovarium* simple, styles two, rarely one or three, stigmas feathery; *fruit* usually a caryopsis, embryo lying on one side of a farinaceous albumen; *herbaceous plants*, with a fibrous or bulbous rhizoma; fistular culm, with solid knots, covered with a coat of silex*; alternate sheathing leaves, the heath slit; *inflorescence*, flowers collected in little spikes, called *locustæ*, arranged in spikes, racemes or panicles.

Found wild in all countries and all climates; in the tropics some species are of great size, fifty to sixty feet high; with respect to their distribution by cultivation, the earth may be regarded as divisible into five provinces, of rice, of maize, of wheat, of rye, and of barley and oats; there are fifty-six British genera.

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* The earth of which flint, rock-crystal, agate, &c., is composed, is so called.

If the last order is more attractive for its beauty, than celebrated for its utility, that of the grasses, on the contrary, considered in the latter point of view, surpasses all others, if the number of human beings dependent on it for existence be made the standard; and rice will, in this case, claim the first place in the order. The Gramineæ are wholesome and nutritious, the *whole plants* to animals, and their fruit to man; and, if only a few are cultivated, it arises from the circumstance of the greater size of the *seed* of those species furnishing the largest quantity of nutriment in the same space; one exception to their wholesomeness must, however, be made in Lolium temulentum, a species of darnel, which is injurious, growing wild in many parts of England. Besides the farinaceous albumen of their seeds, the plants of most generally contain a great deal of sugar, to the presence of which, in abundance, in the sugar-cane, man is indebted for that important addition to his luxuries, and, in the barley, for a very considerable part of his drink, in this and other countries. The quantity of silex, or flint, in the cuticle of some species is so great, that wheat and barley straw, and some others, will melt before a blow-pipe into a perfect glass. Many species are subject to a peculiar disease, and, when in this state, are very poisonous; the *ergot* of rye, as it is called, when that plant is thus attacked, has lately been found to be a most beneficial medicine in particular cases; the ergot of maize, in America, produces a loss of the hair, and even the teeth, of persons or animals who unguardedly feed on it.

Principal Genera:—Saccharum, Triticum, Avena, Sorghum, Hordeum, Milium, Oryza, Zea, Poa, Bambusa, &c.

IN conclusion, the learner may be reminded that in this study, little *real* knowledge can be acquired from books alone. Natural history is essentially a science of observation; elementary works on the subject can scarcely do more than direct a beginner in the best method of observing usefully and accurately; and this remark, perhaps, is more applicable to Botany than to many other branches of the science. Without a careful comparison of each part of a plant described in a book, with a *living specimen*, however clear that description may be, it will be impossible for the pupil to comprehend it distinctly; and this delightful portion of natural history, if its acquisition be attempted within doors only, will become dry and uninstructive, instead of being, as it is, when rightly pursued, under the guidance of Nature herself, a source of inexhaustible wonder, and ever-new pleasure.

Wild flowers should be selected for examination, nor can those persons who are inhabitants of large towns find any difficulty in procuring them; for an hour's walk will bring those who live in the heart of London itself, within reach of more *species** than will be sufficient to make them thoroughly acquainted with all the technical part of the study. Nature is an economical and accessible instructress, and every walk taken in the fields for recreation, may be made a lesson in botany to the eager and active learner.

It must be further remarked, that the humblest, and, in common opinion, the *ugliest* flower that grows upon a heap of rubbish on a road-side, will be found by the botanist to contain within it so much beauty and instruction, as amply to repay him for his pains in its examination.

But the following plants, which are easily to be procured in flower by any one in spring and summer are recommended for study to the beginner in this country, as types of very distinct natural orders:—

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* Certainly not less than two hundred very distinct and obvious species of phænogamous plants may be gathered within a circle of five miles' radius, having St. Paul's for its centre.

Ranunculus; corn-poppy; Shepherd's purse; and wild cabbage, or a *single* stock; Heart's-ease; Mallow; St. John's wort; common Lychnis, or a *single* pink; wild Geranium and stork's bill; Sweet pea or scarlet bean; Dog-rose; Blackberry or bramble; Willow herb; Cow-parsley; Goose-grass; Sun-flower, Leontodon, and Thistle; Borage or Comfrey; Bind-weed; common Nightshade; Primrose; Foxglove; Sage, or mint, or ground ivy; common dock; Chenopodium; Euphorbia; Chestnut; Willow; Arum; rushes; Wild Garlic or common onion; Yellow Iris; and any Grasses.

A good plain magnifying glass will be necessary for examining the minute parts of the flowers; but a very considerable degree of proficiency may be made, before the learner requires any other instrument than a common penknife and a needle. In short, if the *will* of acquiring knowledge is but present, few studies can be so cheaply, so pleasantly, and so usefully attained as botany, and without that *will*, in this, as in every other science, instruction is vain.

ALPHABETICAL LIST of the Principal PLANTS, or their PRODUCE, useful to Man; with their BOTANICAL NAMES, and their CLASSIFICATION in the two Principal Systems.

English Name.	*Genus and Species.*	*Natural Order.*	*Linnæan Class, &c.*
ALDER	Alnus glutinosa	Betulaceæ, exogenæ	Monœcia tetrandria
Alkanet	Anchusa tinctoria	Boraginaceæ, ,,	Pentandria, monogynia
Alligator-pear *or* Avocado	Laurus persea	Lauraceæ, ,,	Enneandria, monogynia
Allspice	Myrtus pimenta	Myrtaceæ, ,,	Icosandria monogynia
Almond	Amygdalus communis	Amygdaleæ, ,,	Icosandria monogynia
Aloe	Aloe spicata	Asphodeleæ, endogenæ	Hexandria monogynia
Anchovy-pear	Grias cauliflora	Guttaceæ, exogenæ	Polyandria monogynia
Anise-seed	Pimpinella anisum	Umbellaceæ, ,,	Pentandria digynia
Apple	Pyrus malus	Pomeæ, ,,	Icosandria di-pentagynia
Apricot	Prunus armeniaca	Amygdaleæ, ,,	Icosandria monogynia
Areca	Areca oleracea	Palmaceæ, endogenæ	Monœcia monadelphia
Arnotto	Bixa orellana	Bixaceæ, exogenæ	Polyandria monogynia
Arrow-root	Maranta arundinacea	Marantaceæ, endogenæ	Monandria monogynia
Artichoke	Cynara scolymus	Cynaraceæ, exogenæ	Syngenesia æqualis
Asafœtida	Ferula asafœtida	Umbellaceæ, ,,	Pentandria digynia
Ash	Fraxinus excelsior	Oleaceæ, ,,	Polygamia diœcia
Asparagus	Asparagus officinalis	Asphodeleæ, endogenæ	Hexandria monogynia
Balsam of Tolu	Myroxylon peruiferum	Leguminaceæ, exogenæ	Diadelphia decandria
Bamboo	Bambusa arundinacea	Graminaceæ, endogenæ	Hexandria monogynia
Banana	Musa sapientum	Musaceæ, ,,	Hexandria monogynia
Barley	Hordeum distichon	Graminaceæ, ,,	Triandria digynia
Bay	Laurus nobilis	Laurinaceæ, exogenæ	Enneandria monogynia
Bean	Vicia faba	Leguminaceæ, ,,	Diadelphia decandria
Beech	Fagus sylvatica	Cupulaceæ, ,,	Monœcia polyandria
Beet-root	Beta vulgaris	Chenopodiaceæ, ,,	Pentandria digynia
Berberry	Berberis vulgaris	Berberaceæ, ,,	Hexandria monogynia

Betel-nut	Piper betel	Piperaceæ, exogenæ	Diandria trygynia
Bilberry	Vaccinium myrtillus	Vacciniaceæ, ,,	Octandria monogynia
Birch	Betula alba	Betulaceæ, ,,	Monœcia triandria
Blackberry	Rubus fruticosus	Rosaceæ, ,,	Icosandria polygynia
Box	Buxus sempervirens	Euphorbiaceæ, ,,	Monœcia triandria
Brazil-nut (Juvia)	Bertholletia excelsa	Lecythaceæ, ,,	Polyandria monogynia
Bread-fruit	Artocarpus incisa	Artocarpeæ, ,,	Monœcia monandria
Brocoli	Brassica oleracea; variety	Cruciaceæ, ,,	Tetradynamia siliquosa
Buckthorn	Rhamnus catharticus	Rhamnaceæ, ,,	Pentandria monogynia
Buck-wheat	Polygonum fagopyrum	Polygonaceæ, ,,	Octandria trigynia
Butter-tree	Bassia ——	Sapotaceæ, ,,	Dodecandria monogynia
Butter-and-Tallow tree	Pentadesma butyracea	Guttaceæ, ,,	Polyandria monogynia
Cabbage	Brassica oleracea	Cruciaceæ, ,,	Tetradynamia siliquosa
Cabbage-palm (*see* Areca)			
Cacao (Chocolate)	Theobroma cacao	Sterculiaceæ, ,,	Polyadelphia decandria
Cajeput-oil	Melaleuca leucodendron	Myrtaceæ, ,,	Polyadelphia polyandria
Calabash-tree	Crescentia cujete	Solanaceæ, ,,	Didynamia angiospermia
Camomile	Anthemis nobilis	Asteraceæ, ,,	Syngenesia superflua
Camphor	Laurus camphora	Lauraceæ, ,,	Enneandria monogynia
Caper-tree	Capparis spinosa	Capparidaceæ, ,,	Polyandria monogynia
Capsicum	Capsicum annuum	Solanaceæ, ,,	Pentandria monogynia
Caraway	Carum carui	Umbellaceæ, ,,	Pentandria digynia
Cardamom	Amomum granum paradisi	Scitaminaceæ, endogenæ	Monandria monogynia
Cardoon	Cynara cardunculus	Cynaraceæ, exogenæ	Syngenesia æqualis
Carob-tree	Ceratonia siliqua	Leguminaceæ, ,,	Polygamia diœcia
Carrot	Daucus carota	Umbellaceæ, ,,	Pentandria digynia
Cashew-nut	Anacardium occidentale	Anacardiaceæ, ,,	Enneandria monogynia
Cassava	Jatropha manihot	Euphorbiaceæ, ,,	Monœcia monodelphia
Castor oil	Ricinus communis	Euphorbiaceæ, ,,	Monœcia monodelphia
Cauliflower	Brassica oleracea; variety	Cruciaceæ, ,,	Tetradynamia siliquosa

English Name.	*Genus and Species.*	*Natural Order.*	*Linnæan Class, &c.*
Cedar of Lebanon	Abies cedrus	Conaceæ, exogenæ	Monœcia monadelphia
Celery	Apium graveolens	Umbellaceæ, ,,	Pentandria digynia
Champignon	Agaricus oreades	Fungaceæ (cellulares)	Cryptogamia
Cherry	Prunus cerasus	Amygdaleæ, exogenæ	Icosandria monogynia
Chestnut	Castanea vesca	Cupulaceæ, ,,	Monœcia polyandria
Chives	Allium schenoprasum	Asphodeleæ, endogenæ	Hexandria monogynia
Cinnamon	Laurus cinnamomum	Laurinaceæ, exogenæ	Enneandria monogynia
Citron	Citrus medica	Aurantiaceæ, ,,	Polyadelphia polyandria
Cloud-berry	Rubus chamæmorus	Rosaceæ, ,,	Icosandria polygynia
Clover	Trifolium pratense	Leguminaceæ, ,,	Diadelphia decandria
Clove-tree	Caryophyllus aromaticus	Myrtaceæ, ,,	Icosandria monogynia
Coco-nut-tree	Cocus nucifera	Palmaceæ, endogenæ	Monœcia hexandria
Coffee	Coffea arabica	Cinchonaceæ, exogenæ	Pentandria monogynia
Coltsfoot	Tussilago farfara	Asteraceæ, ,,	Syngenesia superflua
Colocynth	Cucumis colocynthis	Cucurbitaceæ, ,,	Monœcia monadelphia
Coriander	Coriandrum sativum	Umbellaceæ, ,,	Pentandria digynia
Cork-tree	Quercus suber	Cupulaceæ, ,,	Monœcia polyandria
Cotton-plant	Gossypium herbaceum	Malvaceæ, ,,	Monadelphia polandria
Cow-tree	——— ———	Artocarpeæ, ,,	——— ———
Cranberry	Oxycoccus palustris	Vacciniaceæ, ,,	Octandria monogynia
Cress	Lepidium sativum	Cruciaceæ, ,,	Tetradynamia siliculosa
Cucumber	Cucumis sativus	Cucurbitaceæ, ,,	Monœcia monadelphia
Currant	Ribes rubrum	Grossulaceæ, ,,	Pentandria monogynia
Custard-apple	Anona muricata	Anonaceæ, ,,	Polyandria polygynia
Date-tree	Phœnix dactylifera	Palmaceæ, endogenæ	Diœcia triandria
Deal	Pinus sylvestris	Conaceæ, exogenæ	Monœcia monadelphia
Deadly nightshade	Atropa belladonna	Solanaceæ, ,,	Pentandria monogynia
Dragon-tree	Dracæna draco	Asphodeleæ, endogenæ	Hexandria monogynia
Ebony-tree	Diospyros ebenum	Ebenaceæ, exogenæ	Polygamia diœcia
Elder-tree	Sambucus nigra	Caprifoliaceæ, ,,	Pentandria trigynia

Elm-tree	Ulmus campestris	Ulmaceæ, exogenæ	Pentandria digynia
Endive	Cichorium endivia	Cichoraceæ, ,,	Syngenesia æqualis
Fennel	Fœniculum vulgare	Umbellaceæ, ,,	Pentandria digynia
Fig-tree	Ficus carica	Artocarpeæ, ,,	Polygamia diœcia
Filbert-tree	Corylus avellana]	Cupulaceæ, ,,	Monœcia polyandria
Fir-tree	Pinus sylvestris	Conaceæ, ,,	Monœcia monadelphia
Flax	Linum usitatissimum	Linaceæ, ,,	Pentandria pentagynia
Foxglove	Digitalis purpurea	Scrophulariaceæ,	Didynamia angiospermia
Gamboge	Gambogia gutta & other genera	Guttiaceæ, ,,	Dodecandria monogynia
Garlic	Allium sativum	Asphodeleæ, endogenæ	Hexandria monogynia
Gentian	Gentianea lutea	Gentiaceæ, exogenæ	Pentandria digynia
Ginger	Zingiber officinalis	Zingiberaceæ, endogenæ	Monandria monogynia
Gooseberry	Ribes grossularia	Grossulaceæ, exogenæ	Pentandria monogynia
Granadilla	Passiflora malaformis	Passifloraceæ, ,,	Monandria monogynia
Grape	Vitis vinifera	Vitaceæ, ,,	Pentandria monogynia
Groundsel	Senecio vulgaris	Asteraceæ, ,,	Syngenesia superflua
Guava	Psidium pyriferum	Myrtaceæ, ,,	Icosandria monogynia
Hazel-tree	Corylus avellana	Cupulaceæ, ,,	Monœcia polyandria
Hellebore	Helleborus niger	Ranunculaceæ, ,,	Polyandria polygynia
Hemlock	Conium maculatum	Umbellaceæ, ,,	Pentandria digynia
Hemp	Cannabis sativa	Urticaceæ, ,,	Diœcia pentandria
Hemp (New Zealand)	Phormium tenax	Asphodeleæ, endogenæ	Hexandria monogynia
Henbane	Hyoscyamus niger	Solanaceæ, exogenæ	Pentandria monogynia
Hop	Humulus lupulus	Urticaceæ ,,	Diœcia pentandria
Horehound	Marrubium vulgare	Labiaceæ ,,	Didynamia gymnospermia
Hornbeam	Carpinus betulus	Cupulaceæ ,,	Monœcia polyandria
Horse-radish	Cochlearia armoracia	Cruciaceæ, ,,	Tetradynamia siliculosa
Iceland-moss	Cetraria islandica	Lichenaceæ (cellulares)	Cryptogamia
Indian-corn	Zea mays	Graminaceæ, endogenæ	Monœcia triandria
Indigo	Indigofera tinctoria	Leguminaceæ, exogenæ	Diadelphia decandria

English Name.	*Genus and Species.*	*Natural Order.*	*Linnæan Class, &c.*
Ipecacuanha	Cephaelis ipecacuanha	Cinchonaceæ, exogenæ	Pentandria monogynia
Irish-moss	Chondrius crispus	Algaceæ (cellulares)	Cryptogamia
Jalap	Convolvulus jalapa	Convolvulaceæ, exogenæ	Pentandria monogynia
Jamrosado	Eugenia	Myrtaceæ, ,,	Icosandria monogynia
Jerusalem-artichoke	Helianthus tuberosus	Asteraceæ, ,,	Syngenesia frustranea
Job's-tears	Coix lacryma	Graminaceæ, ,,	Monœcia triandria
Juniper	Juniperus communis	Conaceæ, ,,	Diœcia monadelphia
Kelp	Fucus vesiculosus	Algeraceæ (cellulares)	Cryptogamia
	Salsola kali	Chenopodiaceæ, exogenæ	Pentandria digynia
Larch	Abies laryx	Conaceæ, ,,	Monœcia monadelphia
Lavender	Lavandula spica	Labiaceæ, ,,	Didynamia gymnospermia
Laver	Ulva lactuca	Algaceæ (cellulares)	Cryptogamia
Leek	Allium porrum	Asphodeleæ, endogenæ	Hexandria monogynia
Lemon	Citrus limonum	Aurantiaceæ, exogenæ	Polyadelphia polyandria
Lettuce	Lactuca sativa	Cichoraceæ, ,,	Syngenesia æqualis
Lignum vitæ	Guaiacam officinale	Zigophyllaceæ, ,,	Decandria monogynia
Lime	Tilia rubra	Tiliaceæ, ,,	Polyandria monogynia
Linseed	Linum	Linaceæ, ,,	Pentandria pentagynia
Liquorice	Liquoritia officinalis	Leguminaceæ, ,,	Diadelphia decandria
Logwood	Hæmatoxylon campæchianum	Leguminaceæ, ,,	Decandria monogynia
Love-apple	Solanum lycopersicum	Solanaceæ, ,,	Pentandria monogynia
Lucerne	Medicago sativa	Leguminaceæ, ,,	Diadelphia decandria
Mace	Myristica moschata	Myristicaceæ, ,,	Diœcia monadelphia
Madder	Rubia tinctorum	Stellaceæ, ,,	Tetrandria monogynia
Mahogany	Swietenia mahogani	Cedrelaceæ, ,,	Decandria monogynia
Maize (*see* Indian-corn)			
Manna	Fraxinus rotundifolia	Oleaceæ, ,,	Diandria monogynia
Mangel wurzel	Beta cicla	Chenopodiaceæ, ,,	Pentandria digynia
Mango	Mangifera indica	Anacardiaceæ, ,,	Pentandria monogynia
Mangostan	Garcinia mangostana	Guttaceæ, ,,	Dodecandria monogynia

Maple-tree	Acer campestre	Aceraceæ, exogenæ	Polygamia monœcia
Medlar	Mespilus germanica	Pomeæ, "	Icosandria di-pentagynia
Melon	Cucumis melo	Cucurbitaceæ, "	Monœcia monadelphia
Millet	Sorghum vulgare	Graminaceæ, endogenæ	Polygamia monœcia
Mint	Mentha	Labiaceæ, exogenæ	Didynamia gymnospermia
Monkey-bread	Adansonia digitata	Bombaceæ, "	Monadelphia polyandria
Morel	Morchella esculenta	Fungaceæ (cellulares)	Cryptogamia
Mulberry	Morus nigra	Urticaceæ, exogenæ	Monœcia tetrandria
Mushroom	Agaricus campestris	Fungaceæ (cellulares)	Cryptogamia
Mustard	Sinapis nigra	Cruciaceæ, exogenæ	Tetradynamia siliquosa
Nectarine	Amygdalus nectarina	Amygdaleæ, "	Icosandria monogynia
Nutmeg-tree	Myristica moschata	Myristicaceæ, "	Diœcia monadelphia
Oak-tree	Quercus robur	Cupulaceæ, "	Monœcia polyandria
Oat	Avena sativa	Graminaceæ, endogenæ	Triandria digynia
Ochro	Hibiscus esculentus	Malvaceæ, "	Monadelphia polyandria
Olive-tree	Olea europæa	Oleaceæ, exogenæ	Diandria monogynia
Onion	Allium cepa	Asphodeleæ, endogenæ	Hexandria monogynia
Orange-tree	Citrus aurantia	Aurantiaceæ, exogenæ	Polyadelphia polyandria
Orris-root	Iris florentina	Iridaceæ, endogenæ	Triandria monogynia
Osier	Salix viminalis	Salicaceæ, exogenæ	Diœcia monandria
Parsley	Apium petroselinum	Umbellaceæ, "	Pentandria digynia
Parsnep	Pastinaca sativa	Umbellaceæ, "	Pentandria digynia
Papaw-tree	Carica papaya	Papayaceæ, "	Diœcia decandria
Pea	Pisum sativum	Leguminaceæ, "	Diadelphia decandria
Peach	Amygdalus persica	Amygdaleæ, "	Icosandria monogynia
Pear-tree	Pyrus communis	Pomeæ, "	Icosandria pentagynia
Pepper	Piper nigrum	Piperaceæ, "	Diandria trigynia
Pine	Pinus	Conaceæ, "	Monœcia monadelphia
Pine-apple	Ananassa	Bromeliaceæ, endogenæ	Hexandria monogynia
Plane-tree	Platanus orientalis	Platanaceæ, exogenæ	Monœcia polyandria

English Name.	*Genus and Species.*	*Natural Order.*	*Linnæan Class, &c.*
Plantain	Musa paradisiaca	Musaceæ, endogenæ	Hexandria monogynia
Plum	Prunus domestica	Amygdaleæ, exogenæ	Icosandria monogynia
Pomegranate	Punica granatum	Myrtaceæ, ,,	Icosandria monogynia
Poplar-tree	Populus dilatata	Salicaceæ, ,,	Diœcia hexandria
Poppy	Papaver somniferum	Papaveraceæ, ,,	Polyandria monogynia
Potato	Solanum tuberosum	Solanaceæ, ,,	Pentandria monogynia
Prickly-pear	Cactus opuntia	Cactaceæ, ,,	Icosandria monogynia
Pumpkin	Cucurbita pepo	Cucurbitaceæ, ,,	Monœcia monadelphia
Quassia	Quassia amara	Simarubiaceæ, ,,	Decandria monogynia
Quince	Cydonia vulgaris	Pomeæ, ,,	Icosandria di-pentagynia
Rape-seed	Brassica napus	Cruciaceæ, ,,	Tetradynamia siliquosa
Raspberry	Rubus idæus	Rosaceæ, ,,	Icosandria polygynia
Reed	Arundo donax	Graminaceæ, endogenæ	Triandria digynia
Rhubarb	Rheum palmatum	Polygonaceæ, exogenæ	Enneandria trigynia
Rice	Oryza sativa	Graminaceæ, endogenæ	Hexandria digynia
Rush	Juncus effusus, &c.	Juncaceæ, ,,	Hexandria monogynia
Rose-apple	Eugenia	Myrtaceæ, exogenæ	Icosandria monogynia
Rosewood	Mimosa jacaranda	Leguminaceæ, ,,	Polygamia monœcia
Rye	Secale cereale	Graminaceæ, endogenæ	Triandria dygynia
Saffron	Crocus sativus	Iridaceæ, ,,	Triandria monogynia
Sago	Sagus	Palmaceæ, ,,	Monœcia hexandria
	Cycas circinalis	Cycadaceæ, exogenæ	Diœcia polyandria
Saintfoin	Onobrychys sativa	Leguminaceæ, ,,	Diadelphia decandria
Salep *or* **Salop**	Orchis mascula	Orchidaceæ, endogenæ	Gynandria monandria
	Tacca pinnatifida	Araceæ, ,,	Hexandria monogynia
Samphire	Crithmum maritimum	Umbellaceæ, exogenæ	Pentandria digynia
Sandal-wood	Santalum album	Santalaceæ, ,,	Tetrandria monogynia
Sea-kale	Crambe maritima	Cruciaceæ, ,,	Tetradynamia siliculosa
Senna	Cassia acutifolia	Leguminaceæ, ,,	Decandria monogynia
Shaddock	Citrus decumana	Aurantiaceæ, ,,	Polyadelphia polyandria

Shallot	Allium ascalonicum	Asphodeleæ, endogenæ	Hexandria monogynia
Spinach	Spinacea oleracea	Chenopodiaceæ, exogenæ	Diœcia pentandria
Stramonium	Datura stramonium	Solanaceæ, ,,	Pentandria monogynia
Strawberry	Fragaria vesca	Rosaceæ ,,	Icosandria polygynia
Sugar-cane	Saccharum officinarum	Graminaceæ, endogenæ	Triandria trigynia
Sycamore	Acer pseudo-platanus	Aceraceæ, exogenæ	Polygamia monœcia
Tallow-tree	Stillingia sebifera	Euphorbiaceæ, ,,	Monœcia monadelphia
Tamarind	Tamarindus indica	Leguminaceæ, ,,	Monadelphia triandria
Tapioca	Jatropha manihot	Euphorbiaceæ, ,,	Monœcia monadelphia
Taro	Ervum hirsutum	Leguminaceæ, ,,	Diadelphia decandria
Tarragon	Artemisia dracunculus	Asteraceæ, ,,	Syngenesia superflua
Tea-tree	Camellia bohea	Ternstromiaceæ, ,,	Monadelphia polyandri
Teak-tree	Tectona grandis	Verbenaceæ, ,,	Pentandria monogynia
Teasel	Dipsacus fullonum	Dipsaceæ, ,,	Tetrandria monogynia
Tobacco	Nicotiana tabacum	Solanaceæ, ,,	Pentandria monogynia
Truffles	Tubar cibarium	Fungaceæ (cellulares)	Cryptogamia
Turnip	Brassica napa	Cruciaceæ, exogenæ	Tetradynamia siliquosa
Vegetable-marrow	Cucurbita succada	Cucurbitaceæ, ,,	Monœcia monadelphia
Vetch	Vicia sativa	Leguminaceæ, ,,	Diadelphia decandria
Vine (*see* Grape)			
Walnut	Juglans regia	Juglandaceæ, ,,	Monœcia polyandria
Water-cress	Nasturtium officinale	Cruciaceæ, ,,	Tetradynamia siliquosa
Water-melon	Cucurbita citrullus	Cucurbitaceæ, ,,	Monœcia monadelphia
Wheat	Triticum spelta, &c.	Graminaceæ, endogenæ	Triandria digynia
Willow	Salix	Salicaceæ, exogenæ	Diœcia diandria
Woad	Isatis tinctoria	Cruciaceæ, ,,	Tetradynamia siliculos
Whortle-berry	Vaccinium	Vaccineaceæ, ,,	Octandria monogynia
Yam	Dioscorea	Dioscoreaceæ, ,,	Diœcia hexandria
Yew-tree	Taxus baccata	Conaceæ, ,,	Diœcia monadelphia

THE END.

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